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Distribution and Status of the Northern Leopard Frog, Rana pipiens, in West Virginia

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ABSTRACT

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The Northern Leopard Frog, *Rana pipiens*, is listed as a species of concern by the West Virginia Division of Natural Resources. Because this species is uncommon in West Virginia, information is needed to understand its distribution and conservation needs. I surveyed 14 historic *R. pipiens* locations and 70 Wildlife Management Areas throughout West Virginia beginning in March 2008. *Rana pipiens* was found in four locations; Greenbottom Wildlife Management Area was confirmed through both auditory and visual surveys and the rest were confirmed through visual observations. Besides Greenbottom Wildlife Management Area, all other sites were confirmed by the presence of a single adult or juvenile *R. pipiens*, which does not indicate a viable population. Due to their current distribution, we recommend that the Division of Natural Resources assign an S1 ranking to *R. pipiens* in West Virginia, because the only viable population found is located in Greenbottom Wildlife Management Area.

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TABLE OF CONTENTS

List of Figures

List of Tables

CHAPTER ONE: Distribution and Status of the Northern Leopard Frog *Rana pipiens* in West Virginia

Introduction:

Global trends of amphibian decline are beginning to attract the attention of many researchers and scientists. Since the 1980's about one-third of amphibian species have become globally threatened and 120 may already be extinct (Stuart et al., 2004). A recent study shows that extinction rates of amphibians are currently 211 times the background extinction rate. If all threatened species go extinct, it will rise to 25,000 to 45,000 times greater (McCallum, 2007). Of the previous five mass extinctions that are believed to have occurred, amphibians have survived through each one. Some scientists believe we are currently in the middle of a sixth mass extinction in which amphibians are showing the highest rate of decline (Wake and Vredenburg, 2008).

Many experts are considering an emerging fungal disease called Chytridiomycosis for the cause of the decline of many amphibian populations. Chytridiomycosis is caused by the fungus *Batrachochytrium dendrobatidis* that affects amphibians by infecting the keratinized mouthparts of larvae and keratin in the epidermal cells of adults by preventing cutaneous respiration (Longcore et al., 1999). This disease was first reported in Panama and Australia and was found to be linked with mass amphibian mortalities in the mountainous rainforest regions of these areas (Berger et al., 1998). Since then, the pathogen has been detected in several new areas, including North and South America, Europe, New Zealand, and Africa and has been identified as the cause of several population declines (Ron and Merino, 2000; Bosch et al., 2001; Waldman et al., 2001; Muths et al., 2003; Hanselmann et al., 2004; Weldon et al., 2004).

While Chytrid has been found as the cause of many amphibian population declines and mass mortalities, some studies show that Chytrid is not always to blame. A study done by Daszak et al. (2005) examined preserved amphibians from 1940 to 2001 from the Savannah River Site for Chytrid. Population counts were done there for nine species from 1979 to 2004. Specimens collected during the coolest months were used to optimize chances of detecting Chytrid because the pathogen is the most predominant during cooler months (Daszak et al., 2003). Out of 137 specimens examined, Chytrid was only found on 3 specimens, two bullfrogs, *Rana catesbeiana*, and one southern leopard frog, *Rana sphenocephala*, all collected in December or January (Daszak et al., 2005). Population declines were found in four species including *R. sphenocephala* in 1981. However, analyses of population trends from those times indicated that the decline was the result of an increase in droughts at the Savannah River from 1978 to 2004 (Daszak et al., 2005). For frogs, drought usually means there is not enough time for larvae to develop. This study showed us that all possible factors, including long-term population and environmental data, must be explored before Chytrid can be blamed for declines

Some declines are due to obvious reasons like habitat destruction, modification, and invasive predators but some are occurring in areas where no such threats are known to be happening. The main problem with evaluating whether populations are declining is the lack of data from previous years pertaining to population numbers. A study done at the La Selva Biological Station by Whitfield et al. (2007) showed that 75% of leaf litter amphibians and reptile populations from that area have declined since 1970. Declines were recorded from cooler climates in temperate or mountainous regions of the tropics. Also, these declines happened in short periods of time, as little as 6 months, and the declines in the mountainous regions rarely accompany declines in reptile and bird populations (Whitfield et al., 2008). In this study the

declines found in the La Selva Biological Station are unlikely to be caused by habitat modification because the study area is located in protected old-growth rainforests. The declines are probably not caused by Chytrid or pesticides because no evidence of *B. dendrobatidis* was found in the area and there were no reports of the presence of agrochemical pesticides within the La Selva reserve. The most reasonable cause is climate change in the form of increases in temperature and precipitation frequency which could decrease standing litter mass in the area (Whitfield et al., 2008).

It is difficult to single out one factor as the cause of these declines. Declines may be due to habitat destruction, infectious disease, exposure to harmful chemicals, and climate change. Amphibians could be considered especially vulnerable because they carry out their life cycle in both water and land, are herbivores as larvae and carnivores as adults, and have moist skin that uses cutaneous respiration (Wake and Vredenburg, 2008). These characteristics leave them exposed to a greater amount of threats because of exposure to several habitat types and diets, they are even more at risk to possible impurities in the environment, and they are sensitive to temperature changes as well. Small populations are also at greater risks than others because they are more vulnerable to introduced species and disease. An increase in global temperatures could be devastating for amphibians, especially montane species that will have to either move up mountains to follow cooler temperatures and their normal habitat or it will cease to exist at all (Wake and Vredenburg, 2008). While many question the authenticity of global warming, The Intergovernmental Panel on Climate Change made a decision supporting the actuality of climate change and that it is for the most part related to human activities (Parry et al., 2007).

Introduction of invasive or exotic species can also lead to the decline of certain amphibian populations. Many times, the introduction of *R. catesbeiana* to an area not normally

populated with them can be detrimental to other ranid species like the northern leopard frog, *Rana pipiens*, and the green frog, *Rana clamitans melanota* (Kiesecker and Blaustein, 1997). *Rana catesbeiana* usually compete against greens and leopards for food in the larval stage and are a well known predator for other frogs and tadpoles (Hecnar and M'Closkey, 1997). Also, studies on the diets of *R. catesbeiana* have shown that they commonly feed on smaller emerging juvenile *R. c. melanota* or *R. pipiens* (Werner et al., 1995). In addition to *R. catesbeiana* predating on smaller ranid frogs by feeding on them, studies have shown that *R. catesbeiana* larvae also compete with the larvae of *R. c. melanota* and *R. pipien*s for resources and predators will more readily feed on the larvae of other species of frogs when *Rana catesbeiana* larvae are present (Kupferberg, 1997). When conditions during development are unfavorable, tadpoles will develop more quickly in order to vacate an unappealing environment, resulting in smaller juvenile frogs. Smith (1987) also stated that larvae will remain in the tadpole stages longer when conditions are favorable in order to transform at a greater size. Finally, Degenhardt et al. (1996) found that *R. catesbeiana* is responsible for the local extinction of other vertebrate fauna in some cases.

Exposure to pesticides and other harmful chemicals may also be responsible for the recent increase in amphibian declines. Due to their habitat selection, which usually includes agricultural ponds or industrial areas, frogs and toads will undoubtedly be exposed to pesticides at some stage of their life history (Sanders, 1970). Amphibians can be exposed to a wide variety of chemicals ranging from pesticides, insecticides, and coal combustion residues, and each chemical affects different species in different ways. Genetic variation can also determine how well certain species tolerate exposure to different pesticides (Bridges and Semlitsch, 2001). Habitat destruction can reduce the number of animals in an area and reduce genetic variation. A

study done by Bridges and Semlitsch (2001) showed that reduced genetic variation, or inter-breeding, could affect the tolerance level of *R. sphenocephala* to environmental stressors. Often, exposure to some pollutants do not affect certain species of amphibians like it effects fish or small invertebrates. For example, Sanders (1970) reported that Lindane, the most toxic insecticide to fish, was the least toxic to frog and toad tadpoles. Several studies have been done where certain species were exposed to certain levels of toxins and the effects were measured. Oliver (1964) reported that *R. catesbeiana* and *R. pipiens* tadpoles showed no visible effects of insecticide poisoning several days after applications of 0.25 pounds per acre of bidrin and 1.0 pounds per acre of phosphamidon.

Coal combustion residues (CCR), have become a major pollutant in the United States due to our wide spread use of coal as an energy source. CCR are usually disposed of in aquatic areas and are known to contain around 20 trace elements, which are toxicological concerns because they may have damaging effects on anuran behavior, development, and physiology. For example, a study done on Southern Toads (*Bufo terrestris*) showed that exposure to CCR caused altered calling behavior (Hopkins et al., 1997, 1999). Hopkins et al. (1998, 2000) showed that amphibian larvae are affected by CCR with oral and axial malformations which make feeding difficult and in turn, effect growth. In addition, Snodgrass et al. (2004) showed that CCR affect growth by decreasing mass and decreasing the time it took to reach certain stages of development in larvae of *R. c. melanota* and *R. sylvatica*.

Peterson et al. (2008) performed a study showing that CCR also negatively affected Southern Leopards Frog (*R. sphenocephala*). While mortalities were minimal, oral malformations were present as well as decreased time to certain developmental stages and decreased mass and length when compared to the control group. Oral abnormalities included

missing teeth rows and portions of jaw, either partially or completely. While mortalities did not occur, several generations affected by these growth abnormalities may cause problems for populations sometime in the future. Smaller frogs at metamorphosis may mean smaller frogs at breeding times, which may hurt reproductive success because this success is usually linked to body size; while larger males and females are more successful (Peterson et al., 2008).

Some experts suggest the current decline of amphibian populations could be caused by bacterial pathogens. Anuran amphibians characteristically have a high diversity of naturally occurring microbial species that co-exist with them (Gibbs et al., 1966). However, the effect of stressors like fluctuating water and air temperatures, increases in density, and introduction of harmful chemicals must be considered to determine if naturally occurring microbial species will become a fatal to the animal in question. In a study by Brodkin et al. (1992), *Rana pipiens* were exposed to graded doses of a potential pathogen, *Pseudomonas aeruginosa*, by intraperitoneal inoculation. *Pseudomonas aeruginosa* is a potential pathogen that can be commonly found in most moist environments (Brodkin et al., 1992). Groups of frogs were kept at different temperatures to observe the effects of temperature change on infection rate and were also subjected to different stressors which included increasing the density of frogs in a tank, by decreasing water changes, and by increasing temperatures. After exposure, spleens were dissected and tested for exposure rates. Results showed that *Pseudomonas aeruginosa* can be fatal for *R. pipiens* but only under certain conditions, which in this case was an increase in temperature from 22°C to 29°C (Brodkin et al., 1992).

Amphibians are also commonly exposed to insecticides. Berrill et al. (1995) studied the sensitivity of tadpoles to insecticides in different quantities and in different life stages. Fenitrothion is an insecticide used to control Pine Sawyer Beetles and Spruce Budworms in

forests in New Brunswick, Canada. In this study, the insecticide was applied twice in a 5- to 10-day period and the results showed that amphibians were sensitive to chemical exposure depending on their stage of life when exposed. As tadpoles and embryos, *R. pipiens* were less sensitive to exposure to low pH and pyrethroid insecticides than *R. c. melanota*. Also, *R. pipiens* seemed to be less sensitive to this particular type of insecticide compared to *R. catesbeiana* and *R. c. melanota* and did not suffer mortality until after being exposed for 8 days to 9 parts per million of fenitrothion. Berrill et al. (1995) concluded that tadpoles are affected more than embryos.

Other studies by Berrill et al. (1993, 1994, and 1998) support this finding. Their previous research has showed that embryos are characteristically more resistant to chemicals due to the egg's shielding gelatinous coat as compared to tadpoles. *Rana sphenocephala* tadpoles were observed at several different life stages while exposed to pesticides (Bridges, 2000). Several deformities were observed on the tadpoles in this study. Three tadpoles showed a growth defect that resulted in their ventral surface not forming or closing properly, which left the heart and gills visible and only covered with a thin transparent membrane. One tadpole formed only one hind leg and another formed three front limbs. The majority of the other deformed tadpoles had bends in their tails near the trunk. This study did not show any effect on hatching success of exposed embryos; however, lower weights at metamorphosis were observed. Low mass at metamorphosis can affect survival probability during first winter and reproductive likelihood (Smith, 1987).

It is becoming common knowledge that pesticides and pollutants negatively affect amphibians, but many scientists are trying to establish how they cause mortality and declines. Several studies have been performed to determine if exposure to pesticides weaken immune

systems, making amphibians more vulnerable to diseases or parasites. Amphibians may also be exposed to virulent for which they have not developed an immune system (Carey et al., 1999; Taylor et al., 1999).

Many times, the relationship between parasite and host is a cooperative one, one in which the host can carry out its life even with the parasite present. Gendron et al., (2003) tested exposure of *R. pipiens* to a mixture of agricultural pesticides to determine if they would be more vulnerable to the lungworm *Rhabdias R.e*, a parasite that entered their body through their skin and migrated to their lungs. *Rhabdias R.e* is a common parasite of frogs from the ranid family (Gendron et al., 2003). While mortality rates did not increase after being exposed to the pesticide and parasite, the parasite migrated to the lungs quicker in exposed frogs, which resulted in more adult worms in the lungs. In addition, the parasite developed quicker in the body of the frog, which shortened the amount of time it took for the parasite to reach maturity, which enabled the parasite to reproduce more quickly. The results of this study indicated that the exposure to the pesticides weakened the immune system of the *R. pipiens*, affecting the frog's response to the infection.

Similar to introducing a chemical to an environment, increased exposure to UV-B radiation is also thought to weaken the immune system of amphibian embryos. Kiesecker and Blaustein (1995) found that exposure to both radiation and a pathogenic fungus, *Saprolegnia ferax*, increased the mortality rate of embryos compared to embryos that had only experienced the application of just one of the treatments. This led some experts to believe that UV-B radiation could possibly be responsible for declines in certain populations that have not been exposed to any other factors that would normally cause decline (Blaustein et al., 1994a, 1994b).

Exposure to acidic conditions and UV-B radiation can also affect the mortality of anurans throughout all life stages. Not only do these conditions negatively affect these animals, the time of exposure can also determine how detrimental the effect will be. Vatnick et al. (1999) studied exposure of *R. pipien*s and *R. c. melanota* to acidic conditions and different pH levels. They tested both post- hibernation and post-breeding frogs of each species. Post-hibernation frogs were used to examine the difference that reduced function of the immune system would have because it is thought that during hibernation the functioning of the immune system decreases (Cooper et al., 1992). Until their immune systems are fully restored, this can make frogs emerging from hibernation more vulnerable to a pathogen that might not affect them (Maniero and Carey, 1997). The results of this study indicated that the post-hibernation frogs showed a 100% mortality rate when exposed to the citrate buffer and a pH of 5.5 and post-breeding frogs only showed a 58% rate of mortality. Compared to *R. c. melanota, R. pipien*s had a significantly greater mortality level when exposed to acidic conditions, indicating that this species is more sensitive to pH fluctuations.

In regard to amphibian decline, I believe there is not a singular cause of the drastic decrease in amphibian population numbers around the world. Alternatively, it is more likely that declines are the result of several factors together acting as deterrent to amphibian prosperity. It is also likely that several of these destructive factors are the result of the harmful activities and behavior of man. If this is true, then there is no single solution to this dilemma and an immense amount of effort from several parties will be required to slow amphibian decline. This view can best be summarized by an excerpt from a journal article by David B. Wake and Vance T. Vredenburg (2008).

> "But we can be sure that behind all of these activities is one weedy species, *Homo sapiens*, which has unwittingly achieved the ability to directly affect its own fate and that of most of the other species on this planet. It is an intelligent species that potentially has the capability of exercising necessary controls on the direction, speed, and intensity of factors related to the extinction crisis. Education and changes of political direction take time that we do not have, and political leadership to date has been ineffective largely because of so many competing, short-term demands. A primary message from the amphibians, other organisms, and environments, such as the oceans, is that little time remains to stave off mass extinctions, if it is possible at all" (11472).

Species Description:

The Northern Leopard Frog, *R. pipiens* (Figure 1) belongs to the family Ranidae, which is one of the largest families of frogs in the world (Green and Pauley, 1987). As the common name suggests, *R. pipiens* ranges mostly over the northern portions of North America. It extends from Nova Scotia to the Northwest Territories, throughout the northern parts of the Great Plains and the Rocky Mountains, southward into northern New Mexico and the mountains of Arizona, and towards the East, it extends south to northwestern Virginia and Ohio (Hulse et al., 2001).

Figure 1: Photograph of Female *Rana pipiens,*

Photo by Amanda N. Spriggs

Rana pipiens are medium-sized to large frogs with a moderately slender body and can attain a snout-vent length of 53-102 mm (Green and Pauley 1987). Ranging from green to brown in color, their dorsal surface is covered with asymmetrical black spots that are often bordered by a light, cream color, and the black spots can range from a circular shape to a larger blotch. The dorso-lateral fold extends the whole length of the body down to the groin and the ventral surface and underside of the legs are pale white.

Rana pipiens can be found in a variety of aquatic habitats including swamps, ponds, lakes, marshes, rivers, and creeks, and will also move into terrestrial habitats such as fields, meadows, and pastures during the warmer months (Green and Pauley, 1987). In New York, Whitaker (1961) found that *R. pipiens* occurred most often in marshy areas and pond edges. Overall, this species is a habitat specialist and needs at least three separate habitat types to carry out its life cycle, which complicates habitat requirements. These three habitats include a breeding pond, preferably one lacking fish, a large field or grassy meadow to be used in the summer months for foraging, and an overwintering pond, which can be any well-oxygenated body of water that does not completely freeze over. Due to their permeable skin, it is important that the water conditions of places that *R. pipiens* inhabit remain pristine for them to thrive because water is such an important part of their life cycle. So not only do they need several varieties of habitat, that habitat also has to be in good condition. The main food items of *R. pipiens* consist of insect larvae, vegetable material that was accidentally ingested as an insect was taken, spiders, snails, and other insects (Linzey, 1967).

Rana pipiens are among the first anurans to begin breeding in the early spring months in the Eastern United States. In West Virginia, this species breeds from mid-March to late April and early May (Green and Pauley 1987). Males begin calling usually when water temperatures

reach 10°C and females emerge around the same time but are less conspicuous due to lack of calling and territorial behavior that causes males to be more active (Hine et al., 1981). Females lay anywhere from 300 to 5,000 eggs per egg mass (Merrell, 1977). Eggs generally hatch after 7-20 days and this is dependent on the water temperature (Hine et al., 1981; Pace, 1974). Pace (1974) found that after eggs had hatch, metamorphosis can take place in 85-130 days and this is most likely associated with the availability of resources and the presence or absence of predators. After spending the warm summer months foraging in nearby fields and meadows, Wright (1914) states that *R. pipiens* will begin to hibernate as early as mid-October, or during the time of the first frost.

Anuran species use different types of calls to communicate during distress. These include courtship, territorial encounters, and advertisement (Larson, 2004). Advertisement calls, which are the most conspicuous, are usually short one-note calls and are used for attracting mates and warning other males in the area of their location. *Rana pipiens* has one of the most complex advertisement call patterns of any temperate zone anuran species. Larson's (2004) study, following Pace's (1974) methods, categorized the advertisement of *R. pipiens* into snores, grunts, and chuckles. The specific calls were distinguished by distinct temporal and spectral properties. Water temperatures were recorded when males began calling and Larson (2004) found that the temperatures ranged from 4 to 21°C and that water temperature can affect frequency of grunts and chuckles.. Characteristically, snores usually begin the call and can continue on in several orders of grunts and chuckles.

Amphibians have long been regarded as an excellent biological indicator, which means that they show how current environmental conditions are affecting other species. *Rana pipiens* are considered to be good indicators and are frequently used in laboratories for embryological,

physiological, and anatomical studies (Dole, 1965). Biological indicators are species that alert us to possible problems in the environment. Not only do amphibians have permeable skin that is very susceptible to any harmful chemicals in their environment, they also have a larval period spent in water that is accompanied by gills, which makes them even more susceptible. Also, frogs play two very important roles in the food chain. First, they play a key role in pest management which ranges from the adults feeding on insects to the larvae feeding on carrion. Secondly, they also serve as an important food source themselves. During the early spring months, frogs are one of the few sources of high protein available for many animals such as water fowl that travel through West Virginia in the spring.

It is essential to find as much information as possible about this animal to understand its needs in order for it to survive because it is difficult to protect a species that is not completely understood. Specific information needed includes aspects like distribution, range, and natural history.

The objective of this study was to provide current data that would enable biologists to better understand the distribution and status of the *R. pipiens* in West Virginia. I visited areas where *R. pipiens* had been previously sited and confirm whether populations had survived habitat changes that may have occurred since they were last visited. I also surveyed parts of the state for new populations by investigating Wildlife Management Areas in West Virginia. I collected both larvae and adults and recorded where they were found. Information gathered from my study will fill in present gaps in the upcoming Amphibian and Reptile Atlas in West Virginia and it will also aid the West Virginia Division of Natural Resources in determining if any conservation actions need to be taken for this species.

Methods and Materials:

Research for this study was conducted over two field seasons from early March 2008 until mid-April of 2009. During the first field season, auditory, visual and dip-netting surveys were performed. The second field season primarily consisted of auditory and visual surveys.

Auditory Surveys

For the auditory surveys, the North American Amphibian Monitoring Program (NAAMP) protocol was used. Auditory surveys were conducted during the early spring months when *R. pipiens* were breeding and males were calling. Surveys began after sunset and preferred sampling conditions consisted of little or no wind, a minimum temperature of 5.5°C, and a light rain was optimal. At each site, I would remain stationary for five minutes to allow surrounding fauna to become acclimated to my presence. After this point of acclimation, then I would then listen and record all vocalizations heard according to the NAAMP Amphibian Calling Index. A calling index of 1 indicates that the individuals calling can be counted and there is space between the calls. A calling index of 2 indicates that the calls of individuals can be distinguished, but there is some overlapping of calls. Finally, a calling index of 3 is used when a full chorus can be heard and the calls are constant, continuous, and overlapping.

Visual Surveys

Visual surveys were conducted during the early spring months when *R. pipiens* were breeding and during the summer months when the species could be found foraging for food in grassy meadows. During the early spring months, surveys began after sunset and preferred sampling conditions consisted of little or no wind, a minimum temperature of 5.5°C, and a light

rain was optimal. A Petzel Duo headlamp was used to locate the frogs at night. At each site, the surveyor would walk along the water's edge in order to detect both breeding and post-hibernation adults. Water temperature was recorded where each frog was found.

Dip-net Surveys

After the breeding period ended and it became more difficult to capture frogs, I began surveying for larvae to determine presence or absence at each site. To do this, I used a long handled dip-net to make sweeps in the breeding ponds around areas of aquatic vegetation where eggs would have most likely been deposited. Larvae collected were placed in plastic containers full of water from the breeding pond in order to be identified. If I was unable to identify the tadpole or I thought that I had caught *R. pipiens* larvae, I would bring those larvae back to the Marshall University Herpetology Lab to identify using a microscope and the key to anuran larvae (Green and Pauley, 1987).

Environmental Conditions

At each site visited, the following environmental parameters were recorded: air temperature, soil temperature, water temperature, water pH, and relative humidity. Armored thermometers were used to monitor water and soil temperatures. A Pen-Type thermo-hygrometer was used to record air temperature and relative humidity. A waterproof pH tester 10 was used to measure the water pH. All data were recorded in a "Rite in the Rain" All-Weather no. 350 field book. Environmental data can be reviewed for each site in Appendix 1.

Study Sites

Study sites consisted of historic sites where populations of *R. pipiens* have been known to occur and areas where *R. pipiens* were likely to occur. Historical sites were chosen from the Marshall University Herpetology Museum and the Natural Heritage Program, through the West Virginia Division of Natural Resources. It was important that I surveyed throughout the state because several juveniles have been found in many areas, and it is not known if these are stable populations or if these froglets are from eggs recently transported to these areas by animals like water fowl (T.K. Pauley, personal communication). In addition to historical sites, Wildlife Management Areas were also surveyed and these sites were chosen based on the presence of suitable *R. pipiens* habitat according to the Wildlife Management Area Guide created by the West Virginia Division of Natural Resources and personal communications with those who had previous experience with this species.

Other Site Confirmations

Personal communications with other biologists were used to confirm the presence or absence of *R. pipiens* in several locations. These biologists include people who were either familiar with the distribution of West Virginia amphibians and reptiles or have conducted studies in areas where *R. pipiens* were likely to occur or have conducted studies during the prime breeding time for this species.

Second Season Re-visits

Due to the very short window of time available during the early spring months for surveying *R. pipiens*, the presence or absence of this species still needed to be determined for

several sites; therefore, a second field season was incorporated. Auditory surveys were used to assess these sites and the NAAMP Protocol was used again. The results for any confirmed site will be discussed in the section that reflects the survey method used to confirm the site.

Results:

Seventy sites were surveyed for the presence of *R. pipiens*. Some sites were presence/absence confirmed through visual, auditory, or dip-net surveying. Tables 1 and 2 show the presence and absence of *R. pipiens* at the historical and non-historical sites surveyed in this study, respectively. Most of the historical sites date back to the 1930's and 1940's and some are now private land or no longer present due to the growth of housing developments and industrial parks so it was necessary to illustrate the condition of each historical site that I surveyed. Table 2 also illustrates the site condition of the non-historical sites that I surveyed. Table 3 compiles the sites that were found to have presence of *R. pipiens* and the manner of how presence was determined. Figure 2 shows a map of the state of West Virginia with labels for each site visited.

Auditory Surveys

Sixty-one auditory surveys were conducted at forty-three sites. One site, Greenbottom Wildlife Management area, was confirmed with auditory surveying (Figure 3). This site is a well-known area for *R. pipiens*. At this site, full breeding choruses were heard (calling index of 3 according to the NAAMP Amphibian Calling Index). Table 4 describes the NAAMP Amphibian Calling Index.

Visual Surveys

Ninety-six visual surveys were conducted at all seventy sites visited and some were visited several times. Four sites were confirmed through visual surveying. Along with auditory surveying, Greenbottom Wildlife Management Area was presence confirmed. Frozen Camp Wildlife Management Area in Jackson County (Figure 4), Mount Storm Lake in Grant County (Figure 5), and Canaan Valley National Wildlife Refuge in Tucker County (Figure 6) were also sites that showed confirmed presence through visual surveying.

Dip-net Surveys

Thirty-nine dip-net surveys were conducted at thirty-nine sites in ponds, lakes, or standing water. No presence sites were confirmed through dip-net surveys. Several larvae from other species were captured with this technique, such as *R. clamitans melanota* and *R. catesbeiana*.

Second Season Re-visits

During the second breeding season of *R. pipiens*, nineteen sites were re-visited or visited for the first time. These sites include McClintic Wildlife Management Area, Conaway Run Wildlife Management Area, Frozen Camp Wildlife Management Area, Cedar Creek State Park, Plum Orchard Lake Wildlife Management Area, Little Beaver State Park, Summit Lake Wildlife Management Area, Cranesville Swamp, Upper and Lower Pleasant Creek Wildlife Management Area, Valley Bend Wildlife Management Area, Canaan Valley National Wildlife Refuge, Altona Farm, Edwards Runs Wildlife Management Area, Boaz Wetland, Clifton area, Racine Locks, and several sites in Winfield. *Rana pipiens* were not located in any of these sites.

Study Sites

Appendix 1 contains information on each site visited during this study. Site information includes location, date, environmental parameters taken, species observed at that site, any field notes taken, and survey method used. See Appendix 1.

Discussion:

In 2004, Marshall University graduate student, William B. Sutton performed several studies on *R. pipiens* at the Greenbottom Wildlife Management Area. During one of his study, he compiled data from the Marshall University Herpetology Museum, the West Virginia Natural Heritage Program, and information from relative literature in order to create a current distribution map for *R. pipiens* (Figure 7). The counties highlighted in green are from records that are present in the Marshall University Herpetological Museum or the West Virginia Biological Survey. The counties highlighted in yellow are from records present in other labs or museums, such as the Carnegie Museum of Natural History: Herpetological Collection or else stated somewhere in the literature. The counties in white are the counties that still needed to be surveyed to determine presence or absence.

Since 2004 this is what was accepted as the general distribution map for *R. pipiens*. However, the majority of these records date as far back to the 1930's. Also, the validity of some of these records is questionable because not all of these data entries were made by trained herpetologists. *Rana pipiens* can be easily confused with *R. palustris* due to their appearance and similar calls, and it is my belief that many individuals who thought they found *R. pipiens* in a certain area had actually found *R. palustris*. *Rana pipiens* has two to three rows of irregular oval

dark spots with light borders, and *R. palustris* has two parallel rows of evenly spaced squarish spots. Also, *R. palustris* has a yellow or orange coloration on the inside of the hind legs and groin, which *R. pipiens* lacks. Therefore, it is coming at little surprise that the distribution determined from this study differs so drastically from the distribution map created by Sutton.

Auditory Surveys

Auditory surveys were the second most successful method of determining the presence or absence of *R. pipien*s. Greenbottom Wildlife Management Area is a 1,096-acre wetland located in Cabell and Mason counties bordered by Route 2 to the east and the Ohio River to the west. Fishing in the Ohio River is permitted in this area and hunting prospects include deer, mourning doves, rabbit, squirrel, and waterfowl. This is a well-known area for the occurrence of *R. pipiens*, so the auditory surveys there were expected to yield positive results. Sutton (2004), recently performed studies on the natural history, diet, and common skin infections and malformations of this species, so it was expected that the *R. pipiens* population would still be there. A full breeding chorus was heard at Greenbottom Wildlife Management Area on March 13, 2008 around 7:45 p.m. The conditions that night were overcast, the air temperature was 16.9°C, and the water temperature was 14.2°C. Not only could a breeding chorus be heard, but several *R. pipiens* were found. Two of the animals caught were males and one was a gravid female. A year later, a breeding chorus with a calling index of 2 could be heard on March 17, 2009 at 9:00 p.m., and this was the first record of *R. pipiens* calling at Greenbottom Wildlife Management Area in 2009. The conditions that night were again overcast, the air temperature was 12.3°C, and the water temperature was 9.0°C. March 1 is the earliest record of *R. pipiens* calling in West Virginia (Green and Pauley, 1987).

Visual Surveys

Greenbottom Wildlife Management Area has a large population of *R. pipiens*, due to the present optimal habitat for this species. During the 2008 breeding season, three *R. pipiens* were found, one gravid female, one non-gravid female, and one male. *Rana pipiens* was observed during the summer of 2008, foraging along the banks of ponds and temporary pools. Finally, during the 2009 breeding season, *R. pipiens* could be seen sitting on emergent vegetation in the water as early as February 10; however, they were not calling.

Frozen Camp Wildlife Management Area is located in Jackson County east of Ripley and south of state Route 33 at Marshall. This 2,587-acre Wildlife Management Area consists of two impoundments, Left Fork Lake and Right Fork Lake, both of which are stocked with largemouth bass, bluegill, and channel catfish. The majority of the area is wooded slopes with some open bottomland and a few open ridge tops. Hunting prospects include deer, grouse, rabbit, squirrel, turkey, and waterfowl. Recent Marshall University Graduates, Katy Pawlik and Noah McCoard made the visual survey in this area. They found 5 *R. pipiens* on June 26, 2007 resting on *Carex* sp. Two specimens were measured for SVL (23.9 mm and 22.1 mm) and the other 3 escaped before measurements could be taken. This site was revisited several times during the 2009 breeding season and a breeding chorus was never heard.

Mount Storm Lake is a 1,200-acre reservoir created on the Stony River in Grant County. This lake works in conjunction with the Mount Storm Power Station in order to supply the station with cooling water (U.S. Dept. of Energy, 2006). Dr. Thomas K. Pauley, Professor of Biological Sciences at Marshall University, and Dr. Mark Watson, Professor at the University of Charleston, found a juvenile *R. pipiens* in a strip mine pond on August 16, 2002. Only one *R.*

pipiens was found and there is still some debate as to whether a viable population exists at Mount Storm Lake or if some other circumstance is responsible for the presence of that one *R. pipiens,* such as an egg being transported in on the wings of migratory waterfowl (Personal communications with Dr. Thomas Pauley).

The Canaan Valley National Wildlife Refuge is located in Tucker County. This is a 16,000-acre Refuge that works to preserve the unique wetlands and uplands of this high elevation, moist valley. On September 1, 2007, Noah McCoard, a Marshall University Graduate student, found one *R. pipiens* in a wetland area of the refuge. The wetland area was near a small pond and had some trails going through the area. This area was re-visited by Dr. Thomas Pauley in the spring of 2009 during the breeding season of *R. pipiens* and no breeding choruses were heard here. Also, personal communication with Ken Sturm, a Wildlife Biologist at the Canaan Valley National Wildlife Refuge has indicated the absence of a viable population of *R. pipiens* here. In response to an email inquiring about the presences of *R. pipiens* at the refuge, Sturm said, "We have no records of *Rana pipiens* on the refuge. Years ago, a graduate student from another university told me that she found one on our Beall Tract but did not have a photo and after discussing it further, I was convinced that she had a *R. palustris* not a *R. pipiens*. I've never heard nor seen one on the refuge nor have I found anyone with good documentation of one here." Sturm also indicated that auditory surveys have been conducted regularly throughout this area since 2000 and are now conducted every other year at the refuge. It is unlikely that the record from the Canaan Valley National Wildlife Refuge represents a viable population or a breeding chorus would have been detected by the regular auditory surveys that are conducted by the Wildlife Biologists there.

Dip-net Surveys

Presence of *R. pipiens* was not confirmed through dip-net surveys. This was unusual because I was unable to capture larvae dip-netting in Greenbottom Wildlife Management Area, which is a locality where *R. pipiens* is known to occur. There could be several possible explanations for the low results yielding from this surveying tool. The lack of results could be due to locality. I could have been dip-netting in a certain area of a lake or pond when the *R. pipiens* larvae were in a place I could not access. In addition, there is always the possibility of simply missing the *R. pipiens* larvae with the dip net in that area. However, I do not believe the lack of captured *R. pipiens* larvae was due to poor dip-netting techniques because I was able to capture numerous larvae from other species such as *R. clamitans melanota*, *R. catesbeiana*, and *P. crucifer* from several sites throughout the state.

Finally, the 2008 breeding season may have yielded very low reproductive numbers for *R. pipiens*, which would have resulted in very few larvae. Several factors could have contributed to this such as an insufficient amount of rainfall that year, an abnormally cold winter that decreased the duration of the breeding season, and an increase in pollutants in the area. This theory would explain why larvae from other species were so easy to capture and *R. pipiens* larvae were not. However, I do not believe it is correct to say that the dip-netting method is an ineffective tool for surveying for anuran species just because I was unable to capture any *R. pipiens* larvae. I was able to capture mass quantities of *R. c. melanota*, *R. catesbeiana*, *P. crucifer*, and *Notophthalmus viridescens viridescens* at several different sites throughout the state, which shows that dip-netting is an effective tool for surveying for not only anuran species, but amphibians in general. Wright (1914) said that *R. pipiens* generally "prefer cattail swamps, marshy expanses of other types, grassy overflows, and shallow dead streams. In situations other

than these, they breed sparingly." Insufficient amount of appropriate habitat could be one of the primary indicators for the lack of *R. pipiens* in the state.

Other Site Confirmations

Several other studies have taken place throughout West Virginia that have provided distribution information pertaining to *R. pipiens*. In 2008, Scott J. Albaugh, a recent Marshall University Graduate student, conducted an extensive field study on Bull Skin Run near Wheatland in Jefferson County. His study, "A Habitat Comparison of *Pseudacris f. feriarum* and *Pseudacris c. crucifer* with Emphasis on Associated Plant Communities and Distribution of *Clemmys guttata* and *Pseudacris f. feriarum* in West Virginia," was carried out during the early spring months and several hundred-man hours were spent surveying areas along Bull Skin Run. Throughout the duration of his study, Albaugh (2008) never reported hearing the call of *R. pipiens* or making any sightings of this species and it was concluded that *R. pipiens* populations were not in this area of the state.

Conaway Run Wildlife Management Area is a site that was once confirmed through an auditory survey. This 630-acre Wildlife Management Area is located in Tyler County off state Route 18 approximately 10 miles south of Middlebourne. Hardwood forests, brush cover, and Conaway Run Lake make up the majority of the area. Conaway Lake is stocked with largemouth bass, bluegill, channel catfish, and trout. Hunting prospects include deer, grouse, rabbit, squirrel, beaver, fox, mink, muskrat, raccoon, and some migratory game birds. Dr. Mark Watson, professor of biology at the University of Charleston, confirmed this site on March 24, 2003. The *R. pipiens* breeding chorus was given a calling index of 2 because seven males could be heard calling from different areas of the pond adjacent to the campground but not a full

breeding chorus. This site was re-surveyed in the summer of 2008 in attempt to obtain *R. pipiens* larvae through dip-netting; however, this survey was unsuccessful although several *R. clamitans melanota* and *Pseudacris crucifer* larvae were captured at this site. Throughout March of 2009, this site was re-visited on several occasions in order to hear a breeding chorus that would confirm that *R. pipiens* were still at Conaway Lake. However, after spending several evenings at this site during ideal breeding conditions, it was concluded that the *R. pipiens* no longer exist here. On March 18, a full breeding chorus of *P. crucifer* with a calling index of 3 was heard. On March 28, *P. crucifer* was heard again at a calling index of 2 and *R. palustris* was also heard at a calling index of 1. The cause of the extirpation of this population is unknown.

Other site information was provided from personal communications with Zachary J. Loughman, a 2005 Marshall University Graduate student. Loughman obtained his Masters of Science degree in Dr. Thomas K. Pauley's herpetology lab and became very skilled with the general identification of amphibian and reptiles. During the summer of 2008, Loughman was able to confirm the absence of *R. pipiens* at several sites in the northern panhandle of the state. These sites included Tomlinson's State Park, Hillcrest Wildlife Management Area, and Bear Rocks Lake Wildlife Management Area. In addition, absence confirmed was the Moundsville site, the Benwood site, Burches Run Wildlife Management Area, and Castleman Run Wildlife Management Area, which were all historic *R. pipiens* sites.

Extensive amphibians and reptiles inventories were conducted by Dr. Thomas K. Pauley and others in several areas of the state over the last twenty years which have also helped us in confirming the absence of *R. pipiens* in several places. These sites include: The New River Gorge National River from 1989 to 1992, The Bluestone National Scenic River from 1996 to 2000, The Gauley River National Recreation Area from 1999 to 2004, the wetlands in Dolly

Sods from 1995 to 1996, The Harpers Ferry National Historic Park 2002 to 2004, and a 3-mile stretch of the Mud River in the Milton area from 2002 to 2003 (Pauley, 1993, Pauley and Bailey 1998, Pauley et al. 2003a, 2003b, 2005, 2008). The absence of *R. pipiens* was confirmed at all of these locations.

Study Sites

Appendix 1 contains detailed descriptions of each site visited throughout the duration of this study. Throughout the duration of this study, sixty-nine sites were visited and one hundred and ninety-six surveys, which consisted of auditory, visual, or dip-netting surveys, were conducted at these sites. An overwhelming amount of man hours were spent investigating these sites for the presence of *R. pipiens*. Averages of five to ten hours were spent investigating each site depending on proximity to Huntington, West Virginia, which includes driving time and actual survey time. The majority of the sites did not have proper habitat for *R. pipiens* and those that did have suitable habitat were investigated several times to ensure the presence or absence of *R. pipiens*. Also, any site that had a known occurrence of *R. pipiens* was visited several times to determine whether or not this record represented a single specimen or a viable population.

Overall Summary

Taking all previous surveys and the surveys conducted during this study, it can be concluded that *R. pipiens* has only been found in 4 locations throughout the state. One juvenile was found in a strip mine pond at the Mount Storm Power Station. Five frogs were found in the Frozen Camp Wildlife Management Area but a breeding chorus was not heard during any auditory surveys. One frog was found in the Canaan Valley National Wildlife Refuge. Finally,

Greenbottom Wildlife Management Area has been the only site to yield a full breeding chorus, along with sightings of adults and juvenile; however, no larvae were found there during this study.

There are several factors that can cause the normal flora and fauna of an area to change over the years. Some of these changes can be due to the natural fluctuation of species diversity and others can be due to man-made changes in the area. For example, a population survey was done in Dickinson County, Iowa, 70 years after Frank Blanchard completed the same study in order to study decline (Lannoo et al., 1994). Blanchard did this study because he believed it is important to have baseline data for the assemblage of certain areas Lannoo's study repeated Blanchard's survey but took into account the effects of commercial frog hunters Lannoo's group surveyed for three years through auditory, visual, and looking for larvae. Five species of the 7 found still existed there. No longer there was the Mudpuppy, *Necturus maculosus*, and Blanchard's cricket frog, *Acris crepitans blanchardi*. Two news species were found that Blanchard did not report, *R. catesbeiana*, which was introduced by state fisheries biologists, and the Great Plains toad, *Bufo cognatus*, which migrated into the area.

The study also showed that *R. pipiens* populations had decreased in this area. Several of the frogs in this area were affected by both hunting and habitat loss such as wetland destruction, the introduction of *R. catesbeiana*, or using wetland areas for raising game fish. People interviewed during this study said around the turn of the century, 20 million *R. pipiens* were commercially shipped out of Dickinson County. One source said that this was a major industry at that time and thousands of dollars of checks were cashed at the local bank; the whole town was participating to earn money. Others felt the declines were due to several wetland drainages and the presence of *R. catesbeiana*. Whatever the case, this study is an example of how both

natural and intentional changes can alter the species diversity of an area, which may be the case for *R. pipiens* here in West Virginia.

After completing all site visits and compiling all information obtained during this study, a new West Virginia map of *R. pipiens* occurrences has been made (Figure 8). All sites on this map include records that have been investigated within the last 10 years and were confirmed either by the author or by biologists who are considered experts in this field. While *R. pipiens* were found in a few places, the distribution of viable *R. pipiens* populations in West Virginia appears to be limited to Greenbottom Wildlife Management Area in Cabell County. There are 2 prime sites within Greenbottom Wildlife Management Area that are well known for *R. pipiens* populations, Hoeft Marsh and the main part of the Wildlife Management Area, near the Jenkin's House. During his *R. pipiens* study, Sutton (2004) found the majority of *R. pipiens* in the Hoeft Marsh area and *R. pipiens* was observed there again during personal surveys in the summer of 2008. However, the majority of the 2009 breeding choruses have been heard in the main part of the Wildlife Management Area, which has not been the trend over the last few years. This information may lead us to believe that the populations may be fluctuating between suitable habitat areas or that there may be some other aspect that may be causing them to move such as availability of resources, presence of predators, or poor habitat conditions. Whatever the case may be, I believe that the Greenbottom Wildlife Management Area populations should be monitored to evaluate the activity of *R. pipiens*. In addition, due to the low number of animals found in the state, it is suggested that the state ranking *of R. pipiens* be changed from an S2 ranking to an S1 ranking. An S1 ranking indicates five or fewer documented occurrences of the species in question and that they are extremely rare and critically imperiled. This study only recovered four occurrences of this species, which falls under the S1 category. If this status

change were made, conservation actions may need to be taken to aid in the preservation of the viable *R. pipiens* population at Greenbottom Wildlife Management Area.

Figure 2: Map of West Virginia Sites Surveyed

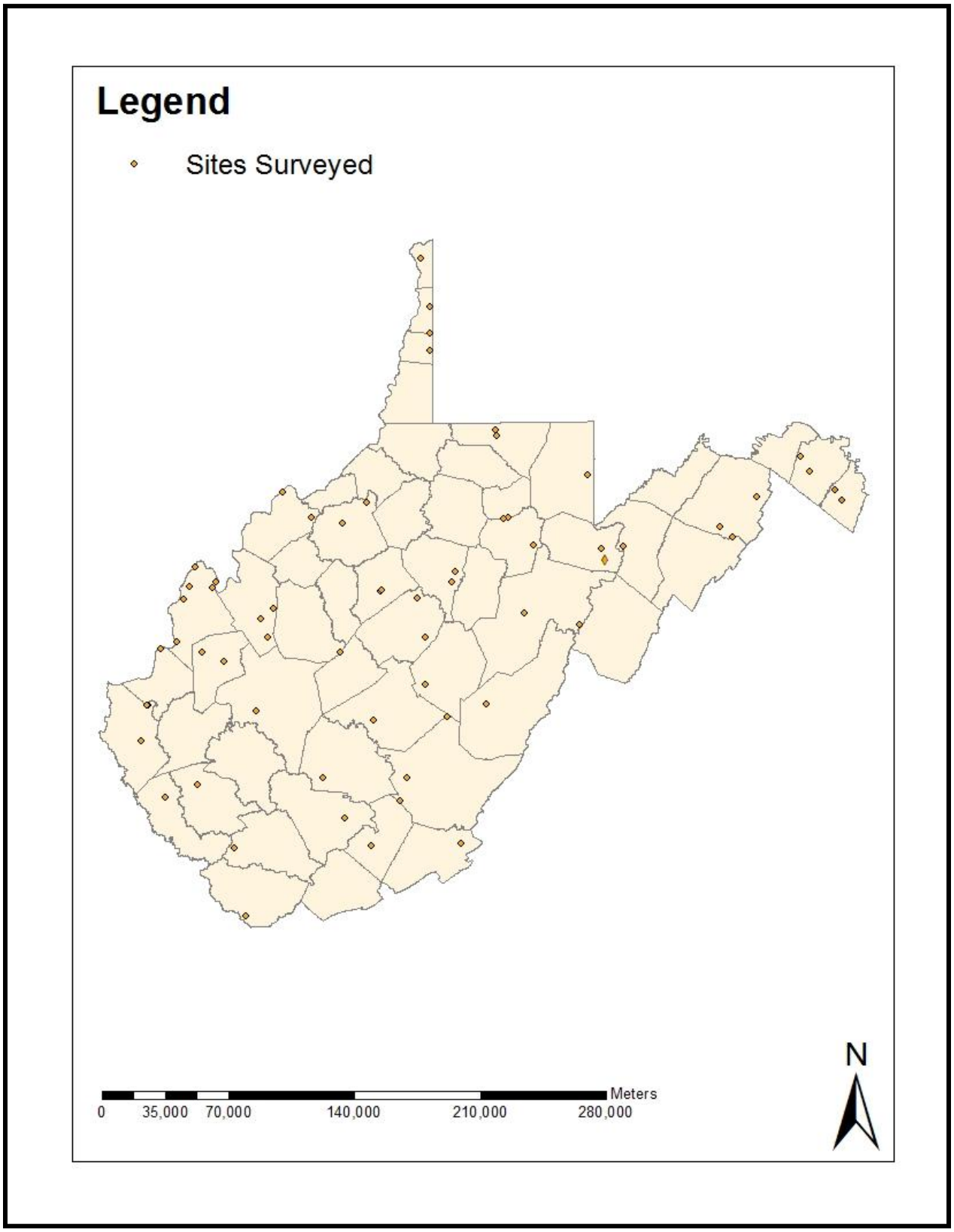

Figure 3: Greenbottom Wildlife Management Area

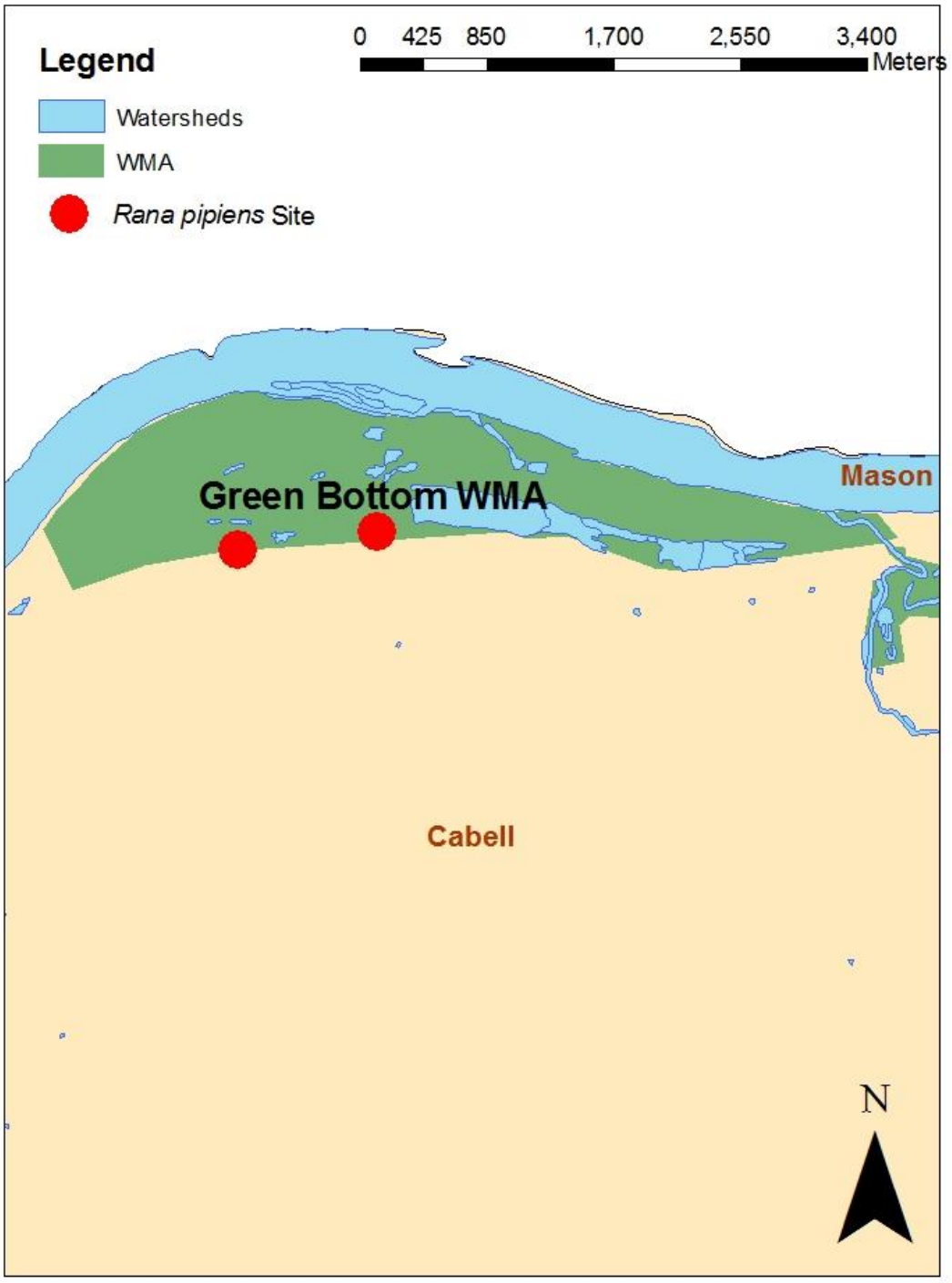

Figure 4: Frozen Camp Wildlife Management Area

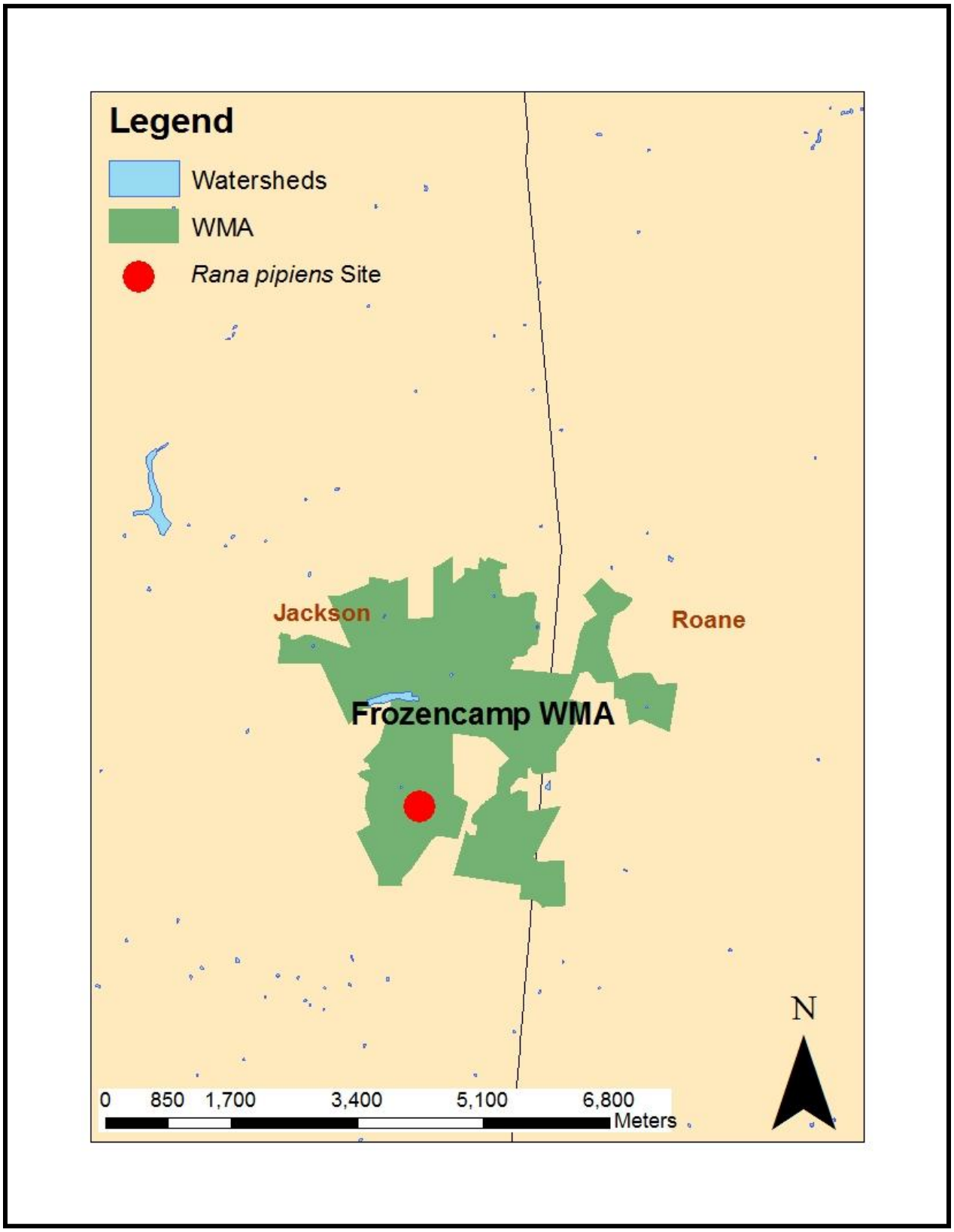

Figure 5: Mount Storm

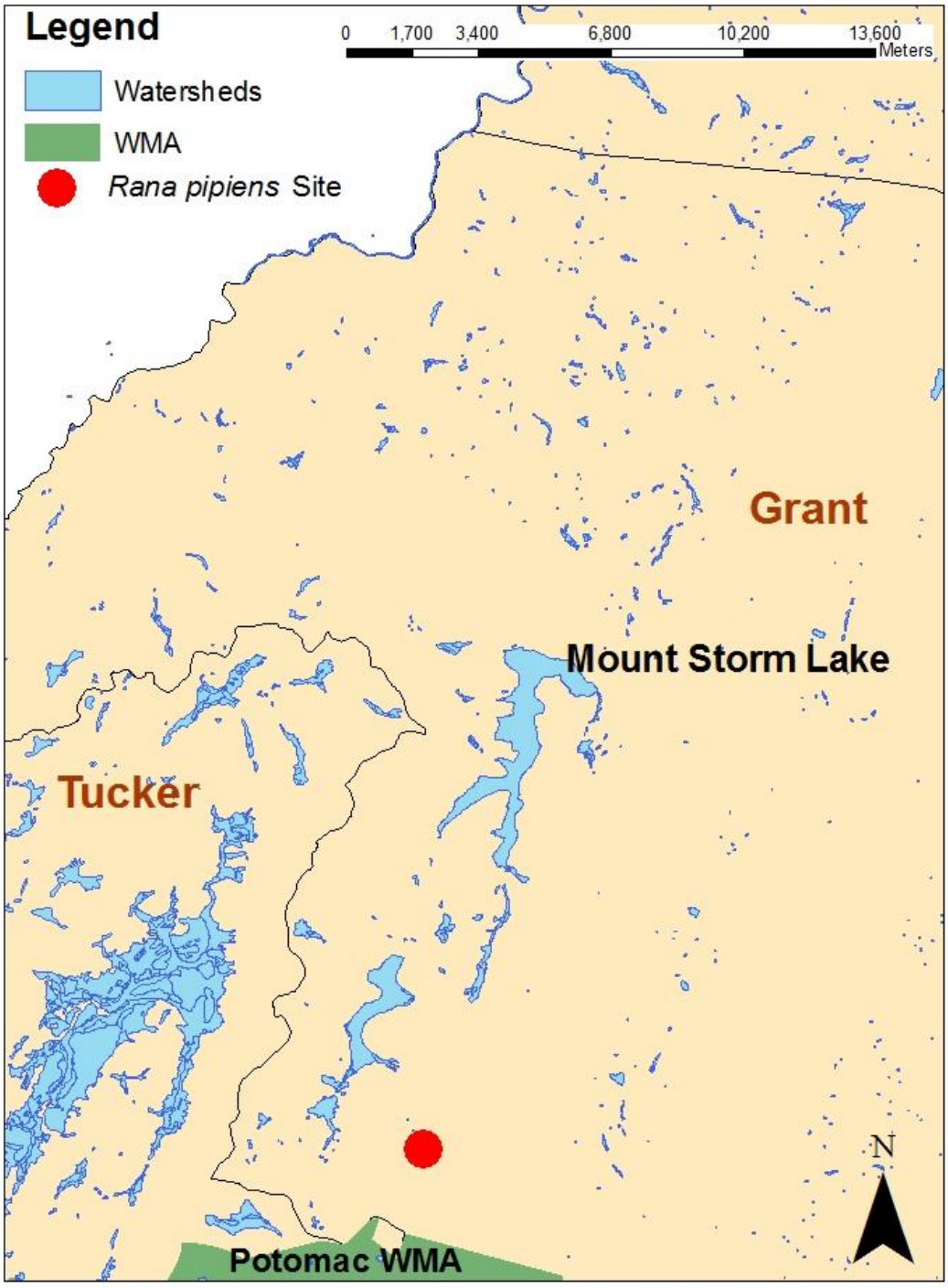

Figure 6: Canaan Valley National Wildlife Refuge

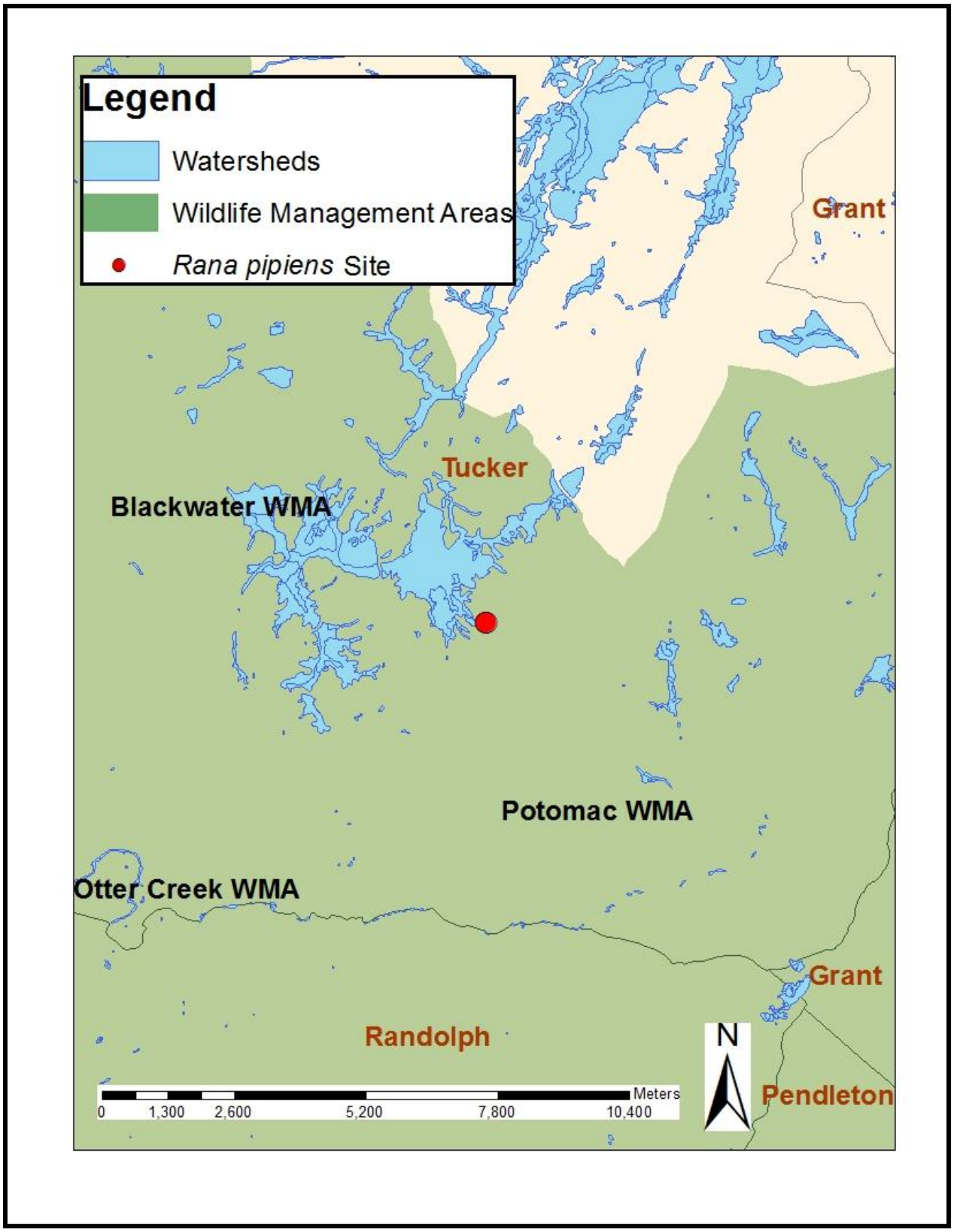

Figure 7: 2004 *Rana pipiens* West Virginia Distribution Map

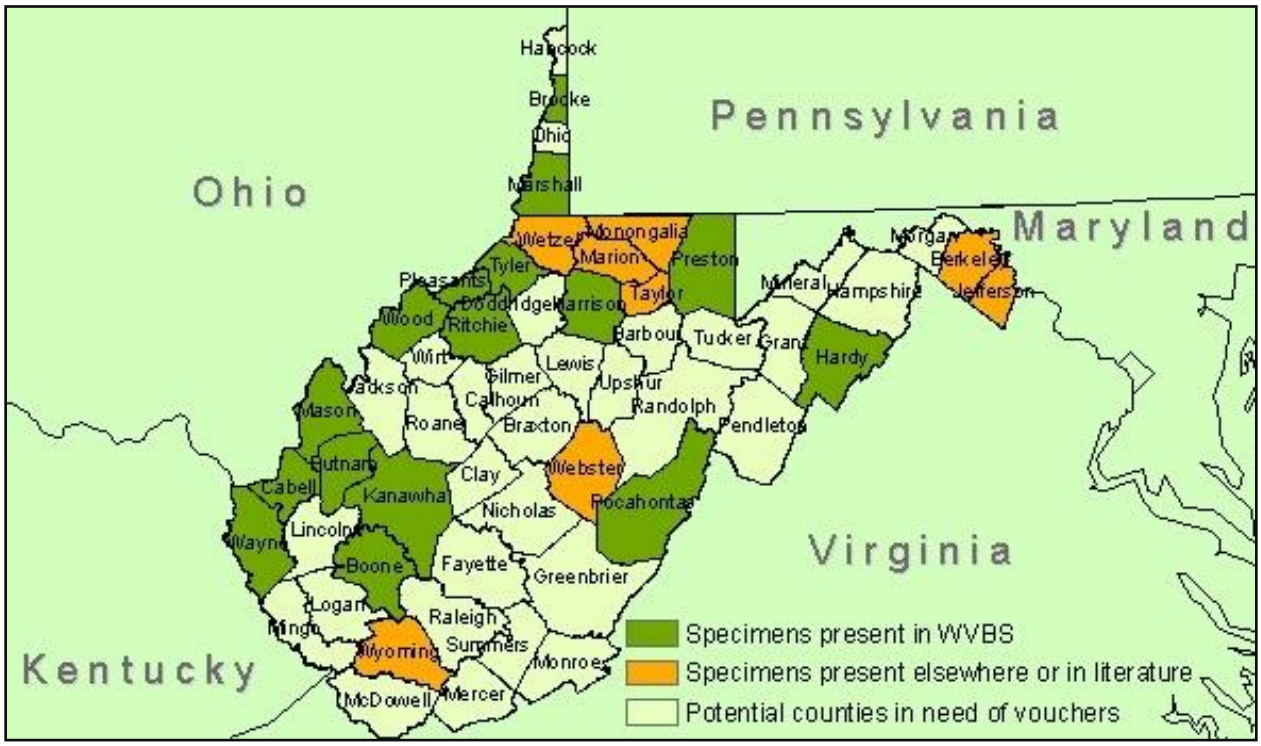

Figure 7: *Rana pipiens* West Virginia Occurrences

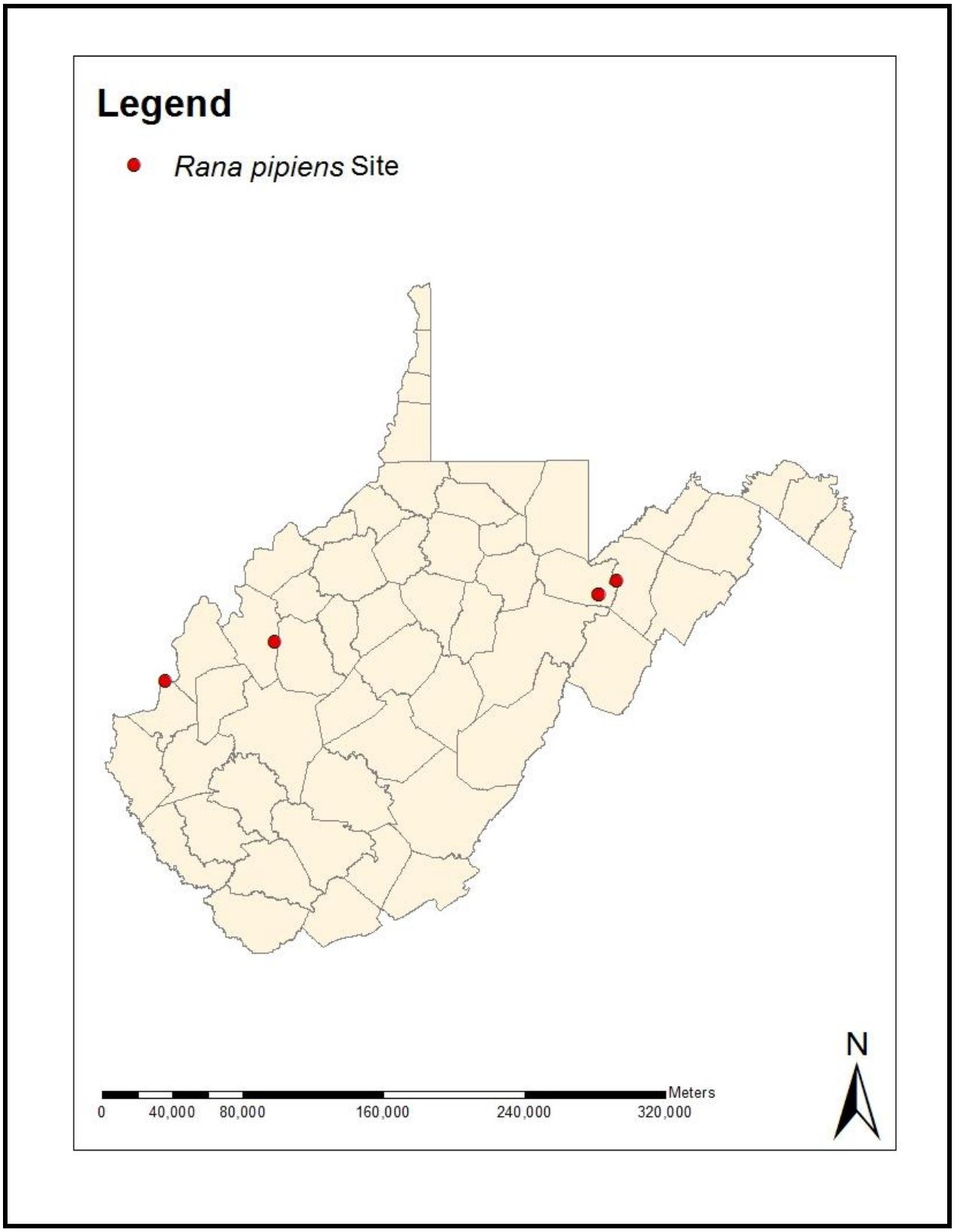

Table 1: Presence and Absence Data from Historical Sites

County	Locality	Collector	Site Condition	Presence
Mason	Two miles east of Point Pleasant	N.D. Richmond	No longer present	No
Cabell	Near the Mason County line	N.B. Green	Present	Yes
Marshall	Benwood	Mabel Hopwood	No longer present	No
Preston	Lake Terra Alta	Jim Handlon	Present	No
Marshall	Moundsville	Mabel Hopwood	No longer present	No
Wayne	Brumfield's pond	N.B. Green	No longer present	No
Marshall	Sherrard	Mabel Gorman	No longer present	No
Putnam	Five miles northeast of Hurricane	Priscilla Deskins	No longer present	No
Brooke	Castleman's Run near Bethany	Mabel Gorman	Present	No
Mason	One mile East of Ashton	Lacy Nichols	No longer present	No
Tyler	Conaway Lake	Thomas K. Pauley	Present	No
Cabell	Greenbottom Swamp	Thomas K. Pauley	Present	Yes
Raleigh	Glade Creek, two miles E of Crow: Little Beaver Creek State Park	Ron Canterbury	Present	No
Berkeley	Doug and Cindy Paine's pond; Sleepy Creek Wildlife Management Area	Thomas K. Pauley	Private property	No
Grant	Mount Storm Lake	Thomas K. Pauley	Private land	Yes

Table 2: Presence and Absence Data from Non-historical Sites

Site	County	Site Condition	Presence
Beech Fork Lake Wildlife Management Area	Cabell & Wayne	Suitable Habitat	No
Beech Fork State Park (Farm Pond)	Cabell & Wayne	Suitable Habitat	No
East Lynn Wildlife Management Area	Wayne	Unsuitable Habitat	No
McClintic Wildlife Management Area	Mason	Suitable Habitat	No
Pond near Moose Lodge in Point Pleasant	Mason	Suitable Habitat	No
Frozen Camp Wildlife Management Area	Jackson	Suitable Habitat	Yes
Rollins Lake Wildlife Management Area	Jackson	Unsuitable Habitat	No
O'brien Lake Wildlife Management Area	Jackson	Unsuitable Habitat	No
Laurel Lake Wildlife Management Area	Mingo	Suitable Habitat	No
R.D. Bailey Lake Wildlife Management Area	Mingo & Wyoming	Unsuitable Habitat	No
Berwind Lake Wildlife Management Area	McDowell	Suitable Habitat	No
Amhert and Plymouth Wildlife Management Area	Putnam	Unsuitable Habitat	No
Kanawha State Forest	Kanawha	Suitable Habitat	No
Woodrum Wildlife Management Area	Jackson	Suitable Habitat	No
Wallback Wildlife Management Area	Clay, Kanawha, & Roane	Suitable Habitat	No
Plum Orchard Lake Wildlife Management Area	Fayette	Suitable Habitat	No
Bluestone Lake Wildlife Management Area	Summers, Mercer, & Monroe	Unsuitable Habitat	No
Moncove Lake Wildlife Management Area	Monroe	Suitable Habitat	No
Short Mountain Wildlife Management Area	Hampshire	Suitable Habitat	No
Warden Lake Wildlife Management Area	Hardy	Suitable Habitat	No
Sleepy Creek Wildlife Management Area	Hardy	Suitable Habitat	No
Leetown Fish Hatchery	Jefferson	Suitable Habitat	No
Altona and Harewood Marsh	Jefferson	Suitable Habitat	No
Bullskin Run	Jefferson	Suitable Habitat	No
Edwards Run Wildlife Management Area	Hampshire	Suitable Habitat	No
Canaan Valley National Wildlife Refuge	Tucker	Suitable Habitat	Yes
Spruce Knob	Randolph	Suitable Habitat	No
Sutton Lake in Elk River Wildlife Management Area	Braxton	Suitable Habitat	No

Burnsville Lake Wildlife Management Area	Braxton	Unsuitable Habitat	No
Stonewall Jackson Lake Wildlife Management Area	Lewis	Unsuitable Habitat	No
Stonecoal Lake Wildlife Management Area	Lewis & Upshur	Suitable Habitat	No
Big Ditch Wildlife Management Area	Webster	Suitable Habitat	No
Summit Lake Recreational Area	Greenbrier	Suitable Habitat	No
Handley Lake Wildlife Management Area	Pocahontas	Suitable Habitat	No
Mason Lake in Pedlar Wildlife Management Area	Monongalia	Suitable Habitat	No
Dixon Lake in Pedlar Wildlife Management Area	Monongalia	Suitable Habitat	No
Tera Alta Lake	Preston	Unsuitable Habitat	No
Mountwood Lake	Wood	Suitable Habitat	No
Northbend State Park (campground)	Ritchie	Suitable Habitat	No
Upper Pleasant Creek Wildlife Management Area	Barbour & Taylor	Suitable Habitat	No
Lower Pleasant Creek Wildlife Management Area	Barbour & Taylor	Suitable Habitat	No
Teter Creek Wildlife Management Area (campground)	Barbour	Suitable Habitat	No
Cross Creek Wildlife Management Area	Brooke	Suitable Habitat	No
Valley Bend Wildlife Management Area	Randolph	Suitable Habitat	No
Tomlinson Run Lake	Hancock	Suitable Habitat	No
Bear Rocks Lakes Wildlife Management Area	Ohio	Suitable Habitat	No
Hillcrest Wildlife Management Area	Hancock	Suitable Habitat	No
Summersville Lake Wildlife Management Area	Nicholas	Unsuitable Habitat	No
Chief Logan State Park	Logan	Unsuitable Habitat	No
Cedar Creek State Park	Gilmer	Suitable Habitat	No
Meadow River Wildlife Management Area	Greenbrier	Suitable Habitat	No
Pond by Ashton Elementary School	Mason	Suitable Habitat	No
Winfield Site 1	Putnam	Suitable Habitat	No
Winfield Site 2	Putnam	Suitable Habitat	No
Boaz_Wetland	Wood	Suitable Habitat	No
Clifton_Area	Mason	Unsuitable Habitat	No
Racine_Locks	Mason	Suitable Habitat	No
Letart_Area	Mason	Unsuitable Habitat	No

Table 3: Presence Confirmed Sites

Site	County	Survey Method Used	Level of Presence
Greenbottom Wildlife Management Area	Cabell	Auditory & Visual	Viable Population
Frozen Camp Wildlife Management Area	Jackson	Visual	Single Adult
Mount Storm Lake	Grant	Visual	Single Juvenile
Canaan Valley National Wildlife Refuge	Tucker	Visual	Single Adult

Table 4: North American Amphibian Monitoring Program Amphibian Calling Index

Amphibian Calling Index	
1	Individuals can be counted; there is space between calls
2	Calls of individuals can be distinguished but there is some overlapping of calls
3	Full chorus, calls are constant, continuous and overlapping

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Appendix 1:

Mount Storm Power Station (Grant County)*

August 16, 2002

Easting – 647272, **Northing** – 4328866

Species Observed:

1 Juvenile *Rana pipiens*

Field Notes:

R. pipiens found in strip mine pond

Survey Method

Visual

Doug and Cindy Paine's Pond (Berkeley County)*

June 10, 2002

Easting – 750445, **Northing** – 4370128

Species Observed:

1 Juvenile *Rana pipiens*

Field Notes:

Found in homeowner's pond

Survey Method

Visual

Conaway Run Wildlife Management Area (Tyler County)*

Marsh 24, 2003

Easting – 512332, **Northing** – 4363901

Species Observed:

Heard *Rana pipiens* calling (Calling Index 2)

Field Notes:

Heard in the upper end of pond, close to campground

Survey Method

Visual and Auditory

North Bend State Park, Campground Pond (Ritchie County)*

April 11, 2003

Easting – 490885, **Northing** – 4341640

Species Observed:

2 *Rana pipiens* calling (Calling index 1)

Field Notes:

Campground pond

Survey Method

Visual and Auditory

***Indicates site confirmed by Dr. Thomas K. Pauley and/or Dr. Mark Watson**

Frozen Camp Wildlife Management Area (Jackson County)

June 26, 2007

Easting – 452759, **Northing** – 42940419

Species Observed:

5 *Rana pipiens* (SVL - 23.9 mm and 22.1 mm)

Field Notes:

Hot and humid, found in *Carex* sp., found by Katy Pawlik and Noah McCoard

Survey Method

Visual

Canaan Valley National Wildlife Refuge (Tucker County)

September 1, 2007

Easting – 636207, **Northing** – 4320820

Species Observed:

1 *Rana pipiens*

Field Notes:

Wetland area near a small pond with some trails going through the area

Survey Method

Visual

Greenbottom Wildlife Management Area – Hoeft Marsh (Cabell County)

March 13, 2008

Easting – 390060, **Northing** – 4271620

Environmental Parameters:

Air Temperature – 16.9°C

Water Temperature - 14.2°C

Relative Humidity – 44.3%

Species Observed:

2 Juvenile *Rana palustris*

3 Juvenile *Rana pipiens*

Heard *Rana pipiens* calling (Calling Index of 3)

Field Notes:

Preliminary study. Overcast

Survey Method

Visual and Auditory

Beech Fork State Park Riparian Area (Cabell and Wayne Counties)

April 4, 2008

Easting – 382951, **Northing** – 4240538

Environmental Parameters:

Air Temperature – 18.9°C

Soil Temperature – 4.0°C

Water Temperature – 14.0°C

Relative Humidity – 64.0%

Species Observed:

Several Adult *Bufo americanus*

Field Notes:

Observed full chorus of *Rana palustris* calling from banks of water and under water. Overcast with slight rain

Survey Method

Visual and Auditory

East Lynn Wildlife Management Area (Wayne County)

April 5, 2008

Easting – 379488, **Northing** – 4220785

Environmental Parameters:

Soil Temperature – 0.0°C

Water Temperature – 10.0°C

Relative Humidity – 50.0%

Species Observed:

None

Field Notes:

Clear skies, experienced several instruments malfunctions

Survey Method

Visual and Auditory

Beech Fork State Park Fishing Pond (Cabell and Wayne Counties)

April 8, 2008

Easting – 382607, **Northing** – 4240456

Environmental Parameters:

Air Temperature – 20.4°C

Water Temperature – 18.0°C

Relative Humidity – 55.0%

pH – 7.8

Species Observed:

Several Adult *Bufo americanus*

Field Notes:

Observed full chorus of *Rana palustris* calling from banks of water and under water. Clear skies

Survey Method

Visual and Auditory

Beech Fork State Park Riparian Area (Cabell and Wayne Counties)

April 8, 2008

Easting – 382951, **Northing** – 4240538

Environmental Parameters:

Air Temperature – 23.6°C

Soil Temperature – 18.7°C

Water Temperature – 18.0°C

Relative Humidity – 51.0%

pH – 7.0

Species Observed:

Several Adult *Bufo americanus*

Field Notes:

Observed full chorus of *Rana palustris* calling from banks of water and under water. Clear skies

Survey Method

Visual and Auditory

Greenbottom Wildlife Management Area – Main Area (Cabell County)

March 13, 2008

Easting – 390992, **Northing** – 4271708

Environmental Parameters

Air Temperature – 13.5°C

Water Temperature – 16.0°C

Relative Humidity – 43.0%

pH – 8.2

Species Observed:

Several Adult *Bufo americanus*

Several Adult *Rana clamitans melanota*

Field Notes:

Clear skies. Swamp like are with abundant emergent vegetation and several pools

Survey Method

Visual and Auditory

McClintic Wildlife Management Area, Pond 15 (Mason County)

April 19, 2008

Easting – 406804, **Northing** – 4307848

Environmental Parameters:

Air Temperature – 20.4°C

Soil Temperature – 18.0°C

Water Temperature – 18.0°C

Relative Humidity – 82.0%

pH – 8.2

Species Observed:

Several *Pseudacris crucifer* larvae (Stage 25)

Field Notes:

Overcast with moderate rain

Survey Method

Visual and Dip-netting

McClintic Wildlife Management Area, Pond 18 (Mason County)

April 19, 2008

Easting – 406530, **Northing** – 4306052

Environmental Parameters:

Air Temperature – 16.9°C

Water Temperature – 15.0°C

Relative Humidity – 82.0%

pH – 6.0

Species Observed:

1 *Rana clamitans melanota* larvae (Stage 25)

Field Notes:

Overcast with moderate rain

Survey Method

Visual and Dip-net

Ashton Pond by Ashton Elementary School (Mason County)

April 19, 2008

Easting – 406530, **Northing** – 4306052

Environmental Parameters:

Air Temperature – 17.0°C

Water Temperature – 18.0°C

Relative Humidity – 84.0%

pH – 7.2

Species Observed:

Several *Pseudacris crucifer* larvae (Stage 24)

Field Notes:

Overcast with moderate rain

Survey Method

Visual and Dip-net

Moose Lodge Pond in Point Pleasant (Mason County)

May 8, 2008

Easting – 402727, **Northing** – 4298887

Environmental Parameters:

Air Temperature – 25.4°C

Water Temperature – 20.0°C

Relative Humidity – 47.0%

pH – 7.7

Species Observed:

None

Field Notes:

Overcast. Very little emergent vegetation

Survey Method

Visual and Dip-net

Frozen Camp Wildlife Management Area, Right Fork Lake (Jackson County)

May 8, 2008

Easting – 452792, **Northing** – 4294040

Environmental Parameters:

Air Temperature – 26.4°C

Soil Temperature – 16.0°C

Water Temperature – 21.0°C

Relative Humidity – 68.0%

pH – 7.1

Species Observed:

1 *Rana clamitans melanota* larvae (Stage 31, Total length – 90.7)

2 *Pseudacris crucifer* larvae (Stage 24)

Field Notes:

Overcast. Abundant emergent vegetation in a large littoral zone (Cattails, etc.)

Survey Method

Visual and Dip-net

O'Brien Lake Wildlife Management Area (Jackson County)

May 8, 2008

Easting – 446015, **Northing** – 4288299

Environmental Parameters:

Air Temperature – 25.6°C

Soil Temperature – 17.0°C

Water Temperature – 21.0°C

Relative Humidity – 66.0%

pH – 7.8

Species Observed:

None

Field Notes:

Clear skies. Impoundment with very little emergent vegetation. No habitat for

Rana pipiens

Survey Method

Visual and Dip-net

Laurel Lake Wildlife Management Area (Mingo County)

May 13, 2008

Easting – 392764, **Northing** – 4189138

Species Observed:

Several *Bufo americanus* larvae (Stage 23)

Field Notes:

Clear skies, very little emergent vegetation. No habitat for *Rana pipiens*

Survey Method

Visual and Dip-net

R.D. Bailey Lake Wildlife Management Area (Mingo and Wyoming Counties)

May 13, 2008

Easting – 431176, **Northing** – 4161303

Environmental Parameters:

Air Temperature – 38.6°C

Soil Temperature – 22.0°C

Water Temperature – 17.0°C

Relative Humidity – 38.0%

pH – 8.0

Species Observed:

None

Field Notes:

Clear skies. No habitat for *Rana pipiens*

Survey Method

Visual and Dip-net

Berwind Lake Wildlife Management Area (McDowell County)

May 13, 2008

Easting – 437752, **Northing** – 4123762

Environmental Parameters:

Air Temperature – 21.8°C

Soil Temperature – 17.0°C

Water Temperature – 24.0°C

Relative Humidity – 73.0%

pH – 7.5

Species Observed:

None

Field Notes:

Clear skies. Small pools of water that appeared to be very polluted. Some pools had a pH of 6.7

Survey Method

Visual and Dip-net

Amherst and Plymouth Wildlife Management Area (Putnam County)

May 18, 2008

Easting – 425189, **Northing** – 4264744

Environmental Parameters:

Air Temperature – 34.2°C

Soil Temperature – 15.0°C

Water Temperature – 26.0°C

Relative Humidity – 78.0%

pH – 8.2

Species Observed:

None

Field Notes:

Overcast. No habitat for Rana pipiens, grassy area with a few puddles next to a parking lot located beside the railroad tracks and the Kanawha River

Survey Method

Visual and Dip-net

Kanawha State Forest (Kanawha County)

May 18, 2008

Easting – 443329, **Northing** – 4237025

Environmental Parameters:

Air Temperature – 34.3°C

Soil Temperature – 14.0°C

Water Temperature – 15.0°C

Relative Humidity – 62.0%

pH – 7.0

Species Observed:

1 basking *Chelydra serpentina serpentina* and found 1 dead *Chelydra s. serpentina*.

Field Notes:

Overcast. Damned up stream with emergent vegetation and cattails on the bank for about a 100 square foot area

Survey Method

Visual and Dip-net

Woodrum Wildlife Management Area (Jackson County)

May 18, 2008

Easting – 449946, **Northing** – 4277913

Environmental Parameters:

Air Temperature – 39.1°C

Soil Temperature – 13.0°C

Water Temperature – 16.0°C

Relative Humidity – 47.0%

pH – 6.9

Species Observed:

2 *Bufo americanus* larvae (Stage 25)

Field Notes:

Overcast. Wooded area with grass and emergent vegetation along the banks, lots of trash in the area

Survey Method

Visual and Dip-net

Wallback Wildlife Management Area (Clay, Kanawha, and Roane Counties)

May 18, 2008

Easting – 490064, **Northing** – 4269690

Environmental Parameters:

Air Temperature – 27.1°C

Soil Temperature – 17.0°C

Water Temperature – 19.0°C

Relative Humidity – 60.0%

pH – 6.8

Species Observed:

4 *Rana sylvatica* larvae (Stage 41)

Field Notes:

Overcast. Permanent pond near a grassy field with lots of emergent vegetation

Survey Method

Visual and Dip-net

Plum Orchard Lake Wildlife Management Area (Fayette County)

May 21, 2008

Easting – 480045, **Northing** – 4199973

Environmental Parameters:

Air Temperature – 23.4°C

Soil Temperature – 13.0°C

Water Temperature – 21.0°C

Relative Humidity – 60.0%

pH – 7.1

Species Observed:

4 *Notophthalmus viridescens viridescens* (newt stage)

1 *Rana clamitans melanota* larvae (Stage – 36, Total length – 70.5 mm)

Field Notes:

Clear skies with few clouds. Large lake with some emergent vegetation

Survey Method

Visual and Dip-net

Bluestone Lake Wildlife Management Area (Summers, Mercer and Monroe Counties)

May 21, 2008

Easting – 507201, **Northing** – 4162797

Environmental Parameters:

Air Temperature – 22.9°C

Soil Temperature – 15.0°C

Water Temperature – 14.0°C

Relative Humidity – 35.0%

pH – 7.8

Species Observed:

None

Field Notes:

Clear skies with few clouds. Impoundment with no emergent vegetation, no habitat for *Rana pipiens*

Survey Method

Visual and Dip-net

Moncove Lake State Park (Monroe County)

May 21, 2008

Easting – 556988, **Northing** – 4163493

Environmental Parameters:

Air Temperature – 19.1°C

Soil Temperature – 13.0°C

Water Temperature – 18.5°C

Relative Humidity – 54.0%

pH – 6.4

Species Observed:

4 *Notophthalmus viridescens viridescens* (newt stage)

6 *Rana clamitans melanota* larvae

R.c.m. 1 (Stage – 41, Total length – 109.5 mm)

R.c.m. 2 (Stage – 38, Total length – 76.8 mm)

R.c.m. 3 (Stage – 36, Total length – 85.0 mm)

R.c.m. 4 (Stage – 37, Total length – 74.6 mm)

R.c.m. 5 (Stage – 30, Total length – 66.0 mm)

R.c.m. 6 (Stage – 25, Total length – 44.7 mm)

Field Notes:

Clear skies with few clouds. Large lake with abundant emergent vegetation including bull rush and common rush

Survey Method

Visual and Dip-net

Short Mountain Wildlife Management Area (Hampshire County)

May 28, 2008

Easting – 700756, **Northing** – 4339679

Environmental Parameters:

Air Temperature – 31.3°C

Soil Temperature – 14.0°C

Water Temperature – 25.5°C

Relative Humidity – 31.0%

pH – 5.3

Species Observed:

1 *Chelydra s. serpentina*

2 female *Notophthalmus viridescens viridescens* (newt stage)

Field Notes:

Clear skies. Some emergent vegetation. No pond, just let out beaver damn streams

Survey Method

Visual and Dip-net

Warden Lake Wildlife Management Area (Hardy County)

May 28, 2008

Easting – 707481, **Northing** – 4333874

Environmental Parameters:

Air Temperature – 22.3°C

Soil Temperature – 17.0°C

Water Temperature – 22.5°C

Relative Humidity – 48.0%

pH – 6.9

Species Observed:

4 Ambystomatid salamanders

1 *Notophthalmus viridescens viridescens* (newt stage)

Several *Rana clamitans melanota* larvae

Field Notes:

Clear skies. Some emergent vegetation

Survey Method

Visual and Dip-net

Sleepy Creek Wildlife Management Area (Berkeley and Morgan Counties)

May 29, 2008

Easting – 745078, **Northing** – 4378686

Environmental Parameters:

Air Temperature – 38.9°C

Soil Temperature – 16.5°C

Water Temperature – 18.5°C

Relative Humidity – 38.0%

pH – 6.8

Species Observed:

1 *Notophthalmus viridescens viridescens* (newt stage)

Heard *Rana clamitans melanota* and *Rana catesbeiana* calling

Field Notes:

Overcast. Lake with emergent vegetation, good habitat for *Rana pipiens*

Survey Method

Visual, Auditory, and Dip-net

Leetown Fish Hatchery (Jefferson County)

May 29, 2008

Easting – 247561, **Northing** – 4359437

Environmental Parameters:

Air Temperature – 45.1°C

Soil Temperature – 14.0°C

Water Temperature – 30.0°C

Relative Humidity – 22.0%

pH – 7.5

Species Observed:

2 *Rana clamitans melanota* larvae

Field Notes:

Overcast. Several ponds with abundant emergent vegetation, good *Rana pipiens* habitat

Survey Method

Visual and Dip-net

Altona Farm (Jefferson County)

May 29, 2008

Easting – 250941, **Northing** – 4353459

Environmental Parameters:

Air Temperature – 46.1°C

Soil Temperature – 32.0°C

Water Temperature – 27.0°C

Relative Humidity – 21.0%

pH – 7.6

Species Observed:

6 *Rana clamitans melanota* larvae

Field Notes:

Overcast. Standing water on both sides of railroad tracks with abundant emergent vegetation

Survey Method

Visual and Dip-net

Edwards Run Wildlife Management Area (Hampshire County)

May 29, 2008

Easting – 721200, **Northing** – 4355971

Environmental Parameters:

Air Temperature – 26.4°C

Soil Temperature – 15.0°C

Water Temperature – 22.0°C

Relative Humidity – 55.0%

pH – 7.3

Species Observed:

1 male *Notophthalmus viridescens viridescens* (newt stage)

Heard *Rana clamitans melanota* and *Rana catesbeiana* calling

Field Notes:

Overcast. Several marsh-like ponds with emergent vegetation and duckweed, good habitat for *Rana pipiens*

Survey Method

Visual, Auditory, and Dip-net

Canaan Valley State Park - Resort Site (Tucker County)

May 30, 2008

Easting – 635041, **Northing** – 4327487

Environmental Parameters:

Air Temperature – 40.0°C

Soil Temperature – 17.5°C

Water Temperature – 23.0°C

Relative Humidity – 24.0%

pH – 6.5

Species Observed:

Several *Rana sylvatica* larvae

Field Notes:

Clear skies. Standing water in a depression near a hill beside a small pond with emergent vegetation

Survey Method

Visual and Dip-net

Spruce Knob Lake Recreation Area (Pendelton County)

May 30, 2008

Easting – 622505, **Northing** – 4284831

Environmental Parameters:

Air Temperature – 45.9°C

Soil Temperature – 17.0°C

Water Temperature – 24.5°C

Relative Humidity – 31.0%

pH – 7.2

Species Observed:

6 *Rana clamitans melanota* larvae

Field Notes:

Clear skies. Surveyed on the opposite side of the impoundment from the lake where outflow of water poured into a grassy field

Survey Method

Visual and Dip-net

Sutton Lake in Elk River Wildlife Management Area (Braxton County)

June 2, 2008

Easting – 537144, **Northing** – 4278399

Environmental Parameters:

Air Temperature – 39.3°C

Soil Temperature – 15.0°C

Water Temperature – 23.0°C

Relative Humidity – 49.0%

pH – 7.7

Species Observed:

Heard *Rana clamitans melanota* calling

1 *Terrapene carolina carolina*

Field Notes:

Clear skies. Surveyed the lake by the campground, few emergent vegetation on the banks

Survey Method

Visual, Auditory, and Dip-net

Stonewall Jackson Lake Wildlife Management Area (Lewis County)

June 2, 2008

Easting – 551775, **Northing** – 4309067

Environmental Parameters:

Air Temperature – 30.1°C

Soil Temperature – 19.0°C

Water Temperature – 27.0°C

Relative Humidity – 53.0%

pH – 7.8

Species Observed:

1 juvenile *Pseudacris crucifer*

Field Notes:

Clear skies. No habitat for *Rana pipiens*

Survey Method

Visual and Dip-net

Stonecoal Lake Wildlife Management Area (Lewis and Upshur Counties)

June 2, 2008

Easting – 553826, **Northing** – 4314346

Environmental Parameters:

Air Temperature – 42.9°C

Soil Temperature – 21.0°C

Water Temperature – 30.5°C

Relative Humidity – 37.0%

pH – 8.9

Species Observed:

4 *Notophthalmus viridescens viridescens* (newt stage, 1 male, 2 female, 1 juvenile)

Field Notes:

Clear skies. Small swamp-like area of standing water on other side of lake impoundment with abundant emergent vegetation

Survey Method

Visual and Dip-net

Big Ditch Wildlife Management Area (Webster County)

June 9, 2008

Easting – 537338, **Northing** – 4251685

Environmental Parameters:

Air Temperature – 49.2°C

Soil Temperature – 22.5°C

Water Temperature – 18.0°C

Relative Humidity – 37.0%

pH – 7.8

Species Observed:

Heard *Rana clamitans melanota* calling

Field Notes:

Clear skies. Single lake with several smaller "marsh-like" habitats around it.

Good habitat for *Rana pipiens*. Lots of carp and trash

Survey Method

Visual, Auditory, and Dip-net

Summit Lake Recreational Area (Webster County)

June 9, 2008

Easting – 549386, **Northing** – 4233736

Environmental Parameters:

Air Temperature – 43.8°C

Soil Temperature – 16.5°C

Water Temperature – 26.5°C

Relative Humidity – 32.0%

pH – 7.8

Species Observed:

Several *Notophthalmus viridescens viridescens* (newt stage, one specimen was found to have some deformities including the enlargement of left leg and some dark coloration on the right ventral side)

Saw either *Rana pipiens* or *Rana palustris*, but could not capture to identify *Rana clamitans melanota* egg mass

Field Notes:

Clear skies. Impoundment with several patches of emergent vegetation on the banks

Survey Method

Visual and Dip-net

Handley Wildlife Management Area (Pocahontas County)

June 9, 2008

Easting – 570991, **Northing** – 4240906

Environmental Parameters:

Air Temperature – 38.0°C

Soil Temperature – 22.5°C

Water Temperature – 28.5°C

Relative Humidity – 29.0%

pH – 7.8

Species Observed:

Heard *Rana clamitans melanota* calling

Several *Notophthalmus viridescens viridescens* (newt stage)

Field Notes:

Clear skies. Some emergent vegetation around edges of pond

Survey Method

Visual, Auditory, and Dip-net

Pedlar Wildlife Management Area, Mason Pond (Monongalia County)

June 15, 2008

Easting – 575891, **Northing** – 4393147

Environmental Parameters:

Air Temperature – 47.8°C

Soil Temperature – 27.0°C

Water Temperature – 23.5°C

Relative Humidity – 18.0%

pH – 7.2

Species Observed:

Several *Rana clamitans melanota* larvae

2 *Rana catesbeiana* larvae (Largest had a Total length of 119.1 mm)

Several *Notophthalmus viridescens viridescens* (newt stage)

Field Notes:

Clear skies. Marsh-like area of standing water on other side of road from main pond. Good *Rana pipiens* habitat, lot of emergent vegetation

Survey Method

Visual and Dip-net

Pedlar Wildlife Management Area, Dixon Pond (Monongalia County)

June 15, 2008

Easting – 576749, **Northing** – 4390162

Environmental Parameters:

Air Temperature – 36.6°C

Soil Temperature – 28.0°C

Water Temperature – 25.0°C

Relative Humidity – 31.0%

pH – 7.8

Species Observed:

5 *Rana clamitans melanota* larvae (Ranging from Stage 40 to 41)

1 juvenile *Rana clamitans melanota* (Stage 45)

Field Notes:

Clear skies. Two ponds, one with more emergent vegetation than other. Not great *Rana pipiens* habitat, no foraging areas

Survey Method

Visual and Dip-net

Tera Alta Lake (Preston County)

June 15, 2008

Easting – 627503, **Northing** – 4368360

Environmental Parameters:

Air Temperature – 29.6°C

Soil Temperature – 21.0°C

Water Temperature – 20.0°C

Relative Humidity – 48.0%

pH – 8.0

Species Observed:

1 crayfish

Field Notes:

Clear skies. Lake with no *Rana pipiens* habitat

Survey Method

Visual and Dip-net

Mountwood Lake (Wood County)

June 19, 2008

Easting – 473626, **Northing** – 4344487

Environmental Parameters:

Air Temperature – 27.2°C

Soil Temperature – 17.5°C

Water Temperature – 19.0°C

Relative Humidity – 43.0%

pH – 7.4

Species Observed:

Juvenile *Rana clamitans melanota* (Stage 45, Total length – 42.5 mm)

Juvenile *Rana clamitans melanota* (Stage 46, Total length – 37.4 mm)

4 *Rana clamitans melanota* larvae

Several Ambystomatid salamanders

Field Notes:

Clear skies. Lake with two swampy areas nearby across the road. Good *Rana pipiens* habitat

Survey Method

Visual and Dip-net

Conaway Run Wildlife Management Area (Tyler County)

June 19, 2008

Easting – 512386, **Northing** – 4303879

Environmental Parameters:

Air Temperature – 36.9°C

Soil Temperature – 18.5°C

Water Temperature – 26.5°C

Relative Humidity – 31.0%

pH – 7.4

Species Observed:

Several *Rana clamitans melanota* larvae

Field Notes:

Clear skies. Lake with areas of standing water near the banks that create marsh-like habitats, good *Rana pipiens* habitat

Survey Method

Visual and Dip-net

North Bend State Park, Campground Pond (Ritchie County)

June 19, 2008

Easting – 490402, **Northing** – 4341630

Environmental Parameters:

Air Temperature – 24.9°C

Soil Temperature – 19.0°C

Water Temperature – 22.0°C

Relative Humidity – 65.0%

pH – 7.1

Species Observed:

1 *Rana catesbeiana* larvae (Stage 41, Total length – 133.7)

Several *Rana clamitans melanota* larvae (Stages 32 – 44)

Field Notes:

Overcast. Small pond with swampy area nearby, some emergent vegetation

Survey Method

Visual and Dip-net

Lower Pleasant Creek Wildlife Management Area (Barbour and Taylor Counties)

June 21, 2008

Easting – 583450, **Northing** – 4344250

Environmental Parameters:

Air Temperature – 30.7°C

Soil Temperature – 19.5°C

Water Temperature – 23.5°C

Relative Humidity – 61.0%

pH – 7.3

Species Observed:

Heard *Rana clamitans melanota* and *Rana catesbeiana* calling

2 *Rana clamitans melanota* larvae

Field Notes:

Overcast. Water impoundment to make a small wetland area with very manicured banks but abundant emergent vegetation in the water

Survey Method

Visual, Auditory, and Dip-net

Upper Pleasant Creek Wildlife Management Area (Barbour and Taylor Counties)

June 21, 2008

Easting – 580803, **Northing** – 4343710

Environmental Parameters:

Air Temperature – 24.2°C

Soil Temperature – 18.5°C

Water Temperature – 23.0°C

Relative Humidity – 75.0%

pH – 8.1

Species Observed:

Heard *Rana catesbeiana* calling (Calling Index 1)

1 *Notophthalmus viridescens viridescens* (newt stage)

Field Notes:

Overcast with light rain. Wetland with abundant emergent vegetation and large grassy areas for foraging. Perfect *Rana pipiens* habitat

Survey Method

Visual, Auditory, and Dip-net

Teter Creek Lake Wildlife Management Area (Barbour County)

June 21, 2008

Easting – 597412, **Northing** – 4328969

Environmental Parameters:

Air Temperature – 44.6°C

Soil Temperature – 17.0°C

Water Temperature – 25.0°C

Relative Humidity – 54.0%

pH – 7.7

Species Observed:

Several *Rana clamitans melanota* larvae (All about Stage 34)

Field Notes:

Overcast with light rain. Campground area near the lake, very little emergent vegetation

Survey Method

Visual and Dip-net

Greenbottom Wildlife Management Area – Hoeft Marsh (Cabell County)

February 8, 2009

Easting – 390060, **Northing** – 4271620

Environmental Parameters:

Air Temperature – 5.5°C

Soil Temperature – 0°C

Water Temperature – 7.0°C

Relative Humidity – 32.0%

Species Observed:

1 dead *Rana pipiens*

Field Notes:

Full moon, clear skies. No frogs calling

Survey Method

Visual and Auditory

Greenbottom Wildlife Management Area – Main Area (Cabell County)

February 10, 2009

Easting – 390992, **Northing** – 4271708

Environmental Parameters:

Air Temperature – 11.2°C

Soil Temperature – 2.0°C

Water Temperature – 7.0°C

Relative Humidity – 67.0%

Species Observed:

1 *Rana pipiens*

1 *Rana palustris*

4 *Rana clamitans melanota*

Heard *Pseudacris crucifer* (Calling Index 1)

Field Notes:

Overcast with light rain.

Survey Method

Visual and Auditory

Greenbottom Wildlife Management Area - Hoeft Marsh (Cabell County)

February 13, 2009

Easting – 390060, **Northing** – 4271620

Environmental Parameters:

Air Temperature – 12.3°C

Soil Temperature – 3.0°C

Water Temperature – 4.0°C

Relative Humidity – 41.0%

Species Observed:

None

Field Notes:

Full moon, clear skies. No frogs calling

Survey Method

Visual and Auditory

Greenbottom Wildlife Management Area – Hoeft Marsh (Cabell County)

February 18, 2009

Easting – 390060, **Northing** – 4271620

Environmental Parameters:

Air Temperature – 13.0°C

Soil Temperature – 2.0°C

Water Temperature – 7.0°C

Relative Humidity – 51.0%

Species Observed:

2 *Rana pipiens* on bank on pond, not calling

1 *Rana clamitans melanota*

Field Notes:

Overcast with high winds

Survey Method

Visual and Auditory

Edwards Run Wildlife Management Area (Hampshire County)

March 6, 2009

Easting – 721200, **Northing** – 4355971

Environmental Parameters:

Air Temperature – 16.3°C

Soil Temperature – 6.0°C

Water Temperature – 7.5°C

Relative Humidity – 35.0%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 1)

Field Notes:

Clear skies

Survey Method

Visual and Auditory

Altona Farm (Jefferson County)

March 6, 2009

Easting – 250941, **Northing** – 4353459

Environmental Parameters:

Air Temperature – 16.8°C

Soil Temperature – 8.0°C

Water Temperature – 7.5°C

Relative Humidity – 35.0%

Species Observed:

None

Field Notes:

Clear skies, low water level

Survey Method

Visual and Auditory

Beech Fork Wildlife Management Area – Riparian Area (Cabell and Wayne Counties)

March 6, 2009

Easting – 382951, **Northing** – 4240538

Environmental Parameters:

Air Temperature – 16.0°C

Soil Temperature – 10.0°C

Water Temperature – 13.0°C

Relative Humidity – 47%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 1) and *Pseudacris brachyphona* (Calling Index 1)

Field Notes:

Overcast with slight rain

Survey Method

Visual and Auditory

Beech Fork State Park Farm Pond along Creek (Cabell and Wayne Counties)

March 6, 2009

Easting – 382607, **Northing** – 4240456

Environmental Parameters:

Air Temperature – 18.2°C

Soil Temperature – 9.0°C

Water Temperature – 12.0°C

Relative Humidity – 43%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2)

Field Notes:

Overcast with slight rain

Survey Method

Visual and Auditory

McClintic Wildlife Management Area, Pond 18 (Mason County)

March 6, 2009

Easting – 406530, **Northing** – 4306052

Environmental Parameters:

Air Temperature – 13.0°C

Soil Temperature – 7.0°C

Water Temperature – 10.0°C

Relative Humidity – 46.0%

Species Observed:

Heard *Rana sylvatica* (Calling 3), *Pseudacris crucifer* (Calling Index 1), and *Pseudacris brachyphona* (Calling Index 2). Saw several *Rana* palustris and 1 *Bufo americanus*

Field Notes:

Overcast with slight rain

Survey Method

Visual and Auditory

Lower Pleasant Creek Wildlife Management Area (Barbour and Taylor Counties)

March 6, 2009

Easting – 583450, **Northing** – 4344250

Environmental Parameters:

Air Temperature –19.9°C

Soil Temperature – 4.0°C

Water Temperature – 5.0°C

Relative Humidity – 56.0%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2) and *Rana sylvatica* (Calling Index 1)

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Cranesville Swamp – Site 1 (Preston County)

March 6, 2009

Easting – 630483, **Northing** – 4377077

Environmental Parameters:

Air Temperature –13°C

Soil Temperature – 0°C

Water Temperature – 0°C

Relative Humidity – 50.0%

Species Observed:

None

Field Notes:

Overcast with light rain, ice still present

Survey Method

Visual and Auditory

Cranesville Swamp – Site 2 (Preston County)

March 6, 2009

Easting – 630339, **Northing** – 4377024

Environmental Parameters:

Air Temperature –13.2°C

Soil Temperature – 0°C

Water Temperature – 0°C

Relative Humidity – 61.0%

Species Observed:

None

Field Notes:

Overcast with light rain, ice still present

Survey Method

Visual and Auditory

Valley Bend Wildlife Management Area (Randolph County)

March 6, 2009

Easting – 592171, **Northing** – 4291244

Environmental Parameters:

Air Temperature – 15.0°C

Water Temperature – 9.0°C

Relative Humidity – 53.0%

Species Observed:

None

Field Notes:

Overcast with light rain, still too cold for calling activity

Survey Method

Visual and Auditory

Summit Lake Recreational Area (Webster County)

March 6, 2009

Easting – 549386, **Northing** – 4233736

Environmental Parameters:

Air Temperature – 7.7°C

Water Temperature – 4.0°C

Species Observed:

None

Field Notes:

Overcast with light rain, still too cold for calling activity

Survey Method

Visual and Auditory

Cedar Creek State Park Pond (Gilmer County)

March 10, 2009

Easting – 513009, **Northing** – 4304098

Environmental Parameters:

Air Temperature – 17.2 °C

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Lower Pleasant Creek Wildlife Management Area (Barbour and Taylor Counties)

March 10, 2009

Easting – 583368, **Northing** – 4344231

Environmental Parameters:

Air Temperature – 17.6 °C

Soil Temperature – 11.0°C

Water Temperature – 11.0°C

Relative Humidity – 33.0%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2) and *Rana palustris* (Calling Index 1)

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Upper Pleasant Creek Wildlife Management Area (Barbour and Taylor Counties)

March 10, 2009

Easting – 580803, **Northing** – 4343710

Environmental Parameters:

Air Temperature – 16.4°C

Soil Temperature – 10.0°C

Water Temperature – 11.0°C

Relative Humidity – 45.0%

Species Observed:

Heard *Rana catesbeiana* (Calling Index 1), *Pseudacris crucifer* (Calling Index 3) and *Rana sylvatica* (Calling Index 3)

Field Notes:

Warm and clear all day, no rain

Survey Method

Visual and Auditory

Little Beaver State Park (Raleigh County)

March 16, 2009

Easting – 492706, **Northing** – 4178103

Environmental Parameters:

Air Temperature – 16.6°C

Soil Temperature – 11.0°C

Water Temperature – 7.0°C

Relative Humidity – 55.0%

Species Observed:

None

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Meadow River Wildlife Management Area Site 1 (Greenbrier County)

March 16, 2009

Easting – 522971, **Northing** – 4187514

Environmental Parameters:

Air Temperature – 15.9°C

Soil Temperature – 10.0°C

Water Temperature – 9.0°C

Relative Humidity – 65.0%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3), *Pseudacris brachyphona* (Calling Index 2), and *Rana sylvatica* (Calling Index 3)

1 *Bufo americanus*

2 *Ambystoma maculatum*

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Meadow River Wildlife Management Area Site 2 (Greenbrier County)

March 16, 2009

Easting – 526645, **Northing** – 4200104

Environmental Parameters:

Air Temperature – 13.6°C

Soil Temperature – 9.0°C

Water Temperature – 7.5°C

Relative Humidity – 73.0%

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3) and *Rana sylvatica* (Calling Index 3)

1 *Rana clamitans melanota*

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Plum Orchard Lake Wildlife Management Area (Fayette County)

March 16, 2009

Easting – 480045, **Northing** – 4199973

Environmental Parameters:

Air Temperature – 14.2°C

Soil Temperature – 10.0°C

Water Temperature – 8.0°C

Relative Humidity – 78.0%

Species Observed:

Several *Notophthalmus viridescens viridescens* (newt stage)

1 *Rana palustris*

1 *Bufo americanus*

Heard *Pseudacris crucifer* (Calling Index 2)

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Ashton Pond by Ashton Elementary School (Mason County)

March 16, 2009

Easting – 399249, **Northing** – 4275699

Species Observed:

6 *Rana palustris* dead on the road

Heard *Pseudacris crucifer* (Calling index 3)

Saw *Notophthalmus viridescens viridescens* in transition

Field Notes:

Overcast with moderate rain

Survey Method

Visual and Auditory

McClintic Wildlife Management Area (Mason County)

March 16, 2009

Easting – 408151, **Northing** – 4309208

Species Observed:

Heard *Rana sylvatica* (Calling Index 2), *Pseudacris crucifer* (Calling Index 3)

Easting – 411865, **Northing** – 4310064

Species Observed:

Heard *Pseudacris brachyphona* (Calling Index 2), *Pseudacris crucifer* (Calling Index 3)

Easting – 411779, **Northing** – 4311525

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Easting – 411606, **Northing** – 4312298

Species Observed:

Heard *Rana sylvatica* (Calling Index 2), *Pseudacris crucifer* (Calling Index 3)

Easting – 410529, **Northing** – 4313614

Species Observed:

Heard *Bufo americanus* (Calling Index 1), *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

Clifton Area 1 (Mason County)

March 16, 2009

Easting – 409710, **Northing** – 4317171

Species Observed:

Heard *Bufo americanus* (Calling Index 2), *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

Clifton Area 2 (Mason County)

March 16, 2009

Easting – 417706, **Northing** – 4315231

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

Racine Locks Area (Mason County)

March 16, 2009

Easting – 420821, **Northing** – 4308524

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

Letart Area (Mason County)

March 16, 2009

Easting – 418851, **Northing** – 4305453

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2)

Survey Method

Visual and Auditory

Boaz Wetland (Wood County)

March 16, 2009

Easting – 457916, **Northing** – 4358310

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2) and *Rana sylvatica* (Calling Index 1)

Survey Method

Visual and Auditory

Greenbottom Wildlife Management Area – Main Area (Cabell County)

March 17, 2009

Easting – 390992, **Northing** – 4271708

Environmental Parameters:

Air Temperature – 12.3°C

Soil Temperature – 10.0°C

Water Temperature – 9.0°C

Relative Humidity – 62.0%

Species Observed:

Heard *Rana pipiens* (Calling Index 2)

Field Notes:

Overcast

Survey Method

Visual and Auditory

Boaz Wetland (Wood County)

March 18, 2009

Easting – 457916, **Northing** – 4358310

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

Conaway Run Wildlife Management Area (Tyler County)

March 18, 2009

Easting – 512332, **Northing** – 4363901

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3)

Survey Method

Visual and Auditory

McClintic Wildlife Management Area, Pond 18 (Mason County)

March 18, 2009

Easting – 406530, **Northing** – 4306052

Environmental Parameters:

Air Temperature – 17.8°C

Soil Temperature – 12.0°C

Water Temperature – 11.5°C

Relative Humidity – 34.0%

Species Observed:

1 *Rana clamitans melanota*

Heard *Rana palustris* (Calling Index 3), *Pseudacris crucifer* (Calling Index 3)

Field Notes:

Overcast with slight rain

Survey Method

Visual and Auditory

Frozen Camp Wildlife Management Area, Right Fork Lake (Jackson County)

March 25, 2009

Easting – 452792, **Northing** – 4294040

Environmental Parameters:

Air Temperature – 22.5°C

Soil Temperature – 11.0°C

Water Temperature – 10.5°C

Relative Humidity – 34.0%

Species Observed:

Heard *Rana palustris* (Calling Index 3) and *Pseudacris crucifer* (Calling Index 3)

Field Notes:

Overcast with light rain

Survey Method

Visual and Auditory

Cedar Creek State Park (Gilmer County)

March 28, 2009

Easting – 513009, **Northing** – 4304098

Species Observed:

None (May be due to fishing activity)

Survey Method

Visual and Auditory

Conaway Run Wildlife Management Area (Tyler County)

March 28, 2009

Easting – 512332, **Northing** – 4363901

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 2) and Rana palustris (Calling Index 1)

Survey Method

Visual and Auditory

Winfield Site 1 (Putnam County)

April 5, 2009

Easting – 504872, **Northing** – 4352843

Environmental Parameters:

Air Temperature – 13.9°C

Species Observed:

Heard *Rana palustris* (Calling Index 3), *Pseudacris crucifer* (Calling Index 3), and *Bufo americanus* (Calling Index 2)

1 *Ambystoma maculatum*

Field Notes:

Strong wind and heavy rain early in the evening, light rain during survey

Survey Method

Visual and Auditory

Winfield Site 2 (Putnam County)

April 5, 2009

Easting – 413391, **Northing** – 4269522

Environmental Parameters:

Air Temperature – 13.9°C

Species Observed:

Heard *Pseudacris crucifer* (Calling Index 3) and Bufo americanus (Calling Index 2)

Field Notes:

Strong wind and heavy rain early in the evening, light rain during survey

Survey Method

Visual and Auditory

Frozen Camp Wildlife Management Area, Right Fork Lake (Jackson County)

April 15, 2009

Easting – 452792, **Northing** – 4294040

Environmental Parameters:

Air Temperature – 22.5°C

Species Observed:

Heard *Rana palustris* (Calling Index 3), *Bufo americanus* (Calling Index 3), and *Pseudacris crucifer* (Calling Index 3)

2 *Bufo americanus*

Field Notes:

Overcast

Survey Method

Visual and Auditory

Canaan Valley National Wildlife Refuge (Tucker County)

April 18, 2009

Easting – 636064, **Northing** – 4325388

Species Observed:

None

Field Notes:

Overcast

Survey Method

Visual and Auditory

Canaan Valley National Wildlife Refuge (Tucker County)

April 18, 2009

Easting – 635522, **Northing** – 4324675

Species Observed:

None

Field Notes:

Overcast

Survey Method

Visual and Auditory

Canaan Valley National Wildlife Refuge (Tucker County)

April 18, 2009

Easting – 634585, **Northing** – 4324346

Species Observed:

None

Field Notes:

Overcast

Survey Method

Visual and Auditory

Canaan Valley National Wildlife Refuge (Tucker County)

April 18, 2009

Easting – 634245, **Northing** – 4324779

Species Observed:

None

Field Notes:

Overcast

Survey Method

Visual and Auditory

Curriculum Vitae

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Objective To develop a career in wildlife conservation and research

Education Marshall University, Huntington, West Virginia
M.S. in Biological Sciences, Expected Graduation Date – May 2009

University of Charleston, Charleston, West Virginia
B.S. in Biology with Minor in Applied Leadership Studies
Magna Cum Laude, May 2007 (GPA – 3.82)

Relevant Courses: General Botany, General Zoology, Writing in Science, Research in Science, Ecology, Anatomy and Physiology, Bacteriology, General Chemistry, Organic Chemistry, Physics, Calculus, Herpetology, Ornithology, Conservation Biology, Plant Taxonomy, and Science Research Portfolio

Relevant Experience

Current
Master's Thesis Research at Marshall University, Huntington, WV

- Conducting a study on the distribution and status of Northern Leopard Frogs, *Rana pipiens*. This is funded by the Division of Natural Resources and will be vital in aiding any conservation efforts being done with this species. Also, study the detection probability of an automated recording system called a Frog Logger, which records animal vocalizations in the field

May 2005 – July 2005
Intern at Thrasher Environmental, Charleston, WV

- Assisted in preparing an EIS on the Cheat Mountain Salamander, *Plethodon nettingi*, a federally threatened species

May 2006 - July 2006
Research Experience for Undergraduates (REU) participant at Georgia Southern University sponsored by the National Science Foundation, Statesboro, Georgia
Lab Assistant:

- Phylogenetic Studies of Bat Pollinated Flowers in Bignoniaceae

July 2006
Research Assistant

- Assisted Dr Phil Clem, University of Charleston, with mist netting to capture bat specimens for a National Youth Science Camp demonstration

August 2007
Research Assistant with Marshall University, Huntington, WV

- Assisted fellow graduate student in project involving the migration of ambystomid salamanders to breeding pools by monitoring pitfalls and drift fence arrays

August 2007 – May 2008
Lab Assistant in Marshall University Paleontology Lab, Huntington, WV

- Created interactive study guides with Microsoft Office PowerPoint 2007 for Marshall University Human Anatomy (BSC 227) students under advisory of Dr. Suzanne Strait

August 2007 – May 2009
Herpetology Journal Club at Marshall University, Huntington, WV

- Met weekly to discuss herpetology related articles from peer-reviewed journals

August 2007 – May 2009
West Virginia Assistant Coordinator for the North American Amphibian Monitoring Program (NAAMP)

- Ensuring that volunteer candidates have taken and passed frog calling quiz which makes them eligible to participate in program
- Assigning routes to volunteers in West Virginia
- Preparing and sending out route packages to volunteers
- Managing NAAMP database where survey information is entered and stored

January 2008 - Current
Research Assistant in Marshall University Herpetology Lab, Huntington, WV

- Studied identification of anuran larvae based on larval characteristics
- Entered West Virginia herpetological survey records into a database for the West Virginia amphibian and reptile atlas. Funded by the West Virginia Division of Natural Resources
- Responsible for general organization of the lab
- Currently performing inventory of specimens collected for the West Virginia Atlas Database

September 2008
Research Assistant with Marshall University, Huntington, WV
Assisted fellow graduate student in study concerning the presence of amphibian chytrid fungus in amphibian populations of West Virginia

- Surveyed West Virginia amphibian species of greatest conservation need
- Recorded data
- Sampled amphibian populations using alcohol preserved swabs and proper hygiene

September 2008
Research Assistant with Marshall University, Huntington, WV
Assisted the USDA Forest Service with study of the effects of multi-use trails on populations of *Plethodon nettingi* (Cheat Mountain Salamander), a federally threatened species

- Set up study transects

Conferences Attended

Spring 2007
Presenter at Chi Beta Phi Conference at Wheeling Jesuit University in Wheeling, West Virginia

April 2007
Attended the 69th Annual Meeting Association of Southeastern Biologists (ASB) in Spartanburg, South Carolina

April 2007
Presenter at the 70th Annual Meeting Association of Southeastern Biologists (ASB) in Birmingham, Alabama

- A Chronological Comparison of Body Size of West Virginia *Rana pipiens* from the 1940's and the 1990's by Skeletochronology

Teaching Experience

Spring 2007
Lab Assistant for General Zoology at the University of Charleston
March 2007
Awarded an Anatomy Lab Teaching Assistant position at Marshall University

- Tutored Anatomy students

September 2009

Selected as a Master TA to speak at the 2009 Marshall University Teaching Assistant Orientation

Grants Received

December 2007
Prepared grant proposal for the West Virginia Division of Natural Resources

- Distribution and Status of Northern Leopard Frog, *Rana pipiens*

January 2008
Received grant funding from the West Virginia Division of Natural Resources in the amount of $7,194 to conduct a survey on the status and distribution of the Northern Leopard Frog, *Rana pipiens*

May 2008
Received grant funding from the Marshall University Graduate College in the amount of $500 to conduct a survey on the status and distribution of the Northern Leopard Frog, *Rana pipiens*

Volunteer Work & Activities

Volunteer Judge in 2009 South Point High School Science Fair, Ohio
Volunteered at Charleston/Kanawha Humane Association, WV
Chi Beta Phi
Charleston A.I.D.S Network (CAN)
Student Government Association: Vice President of Communications
American Chemical Society: Secretary
Food Services Committee: SGA Representative of Committee
Women's Tennis: Varsity Team, University of Charleston

Scholarships & Honors

Welch Colleague Scholarship Recipient
Promise Scholarship Recipient
Timothy Marcum Scholarship Recipient
Arch Coal Scholarship Recipient
John F. and Ruth B. McGee Endowed Scholarship Recipient

Memberships

American Association for the Advancement of Science (AAAS)

References

Dr. Thomas K. Pauley, Professor of Biological Sciences and Advisor
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Dr. Phillip D. Clem, Associate Professor of Biology and Bradford Chair of Natural Science
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